THE AMERICAN BREEDERS MAGAZINE

"To the solid ground of Nature trusts the mind which builds for aye."—WORDSWORTH

Vol. II Fourth Quarter, 1911 No. 4

ALBRECHT DANIEL THAER

1752–1828

Ideas grow at a painfully and almost discouragingly slow rate. The only people whom nature seems to have fitted to nurse ideas with becoming patience and optimism are reformers and scientists.

Our modern science of plant breeding dates back to an idea which was born in the mind of the botanist Camerarius, who in 1694 published a work "De sexu plantarum epistola" in which he cites a series of experiments to prove the nature of sexual reproduction in plants. Camerarius, by the way, was the first scientist to resort to experiment in his search for facts. In this case he worked chiefly with maize and castor beans. About 1760 Koelreuter, professor of natural history at a German university, for the first time successfully hybridized plants, and thus established beyond a doubt not only the sexuality of plants but also that in all essentials they are subject to the same laws of reproduction as animals. Other scientists continued Koelreuter's work, notably Gaertner and Sprengel, but the idea of the sexuality of plants remained housed within the precincts of the savant's studies and laboratories and did not find its way into practical application in agriculture until about the end of the eighteenth century. The man whose vision was clear, and who knew how to make the laboratory knowledge dynamic, was Albrecht Daniel Thaer. He has variously been called the "great agricultural reformer" and the "grand-master of agriculture" and the like, in recognition of the fact that he laid the foundation of the scientific agriculture of today. Among the diverse interests of his active and crowded career, the importance and possibilities of plant breeding did not escape his attention.

Thaer was born in the town of Celle, in the province of Hanover, Germany, the son of a physician. After a study of medicine at the University of Goettingen, he associated with his father in practice and continued alone after the death of the latter. In 1786 Thaer purchased a suburban residence with eight acres of ground, which he immediately began to cultivate intensively. He had noticed the

shortcomings of the farming done by farm owners of the country surrounding Celle and in the province generally. He saw lack of rational farm management; lack of intensive methods; employment of an excess of hand labor owing to lack of machinery suitable for the use of horse power; too much reliance on fallowing; and practically no crop rotation. The aim he set himself was to make a practical demonstration that farming was nowhere more satisfacfactory and remunerative than on the lands near Celle. In 1804 he removed to Möglin near Berlin and founded the Möglin Agricultural Institute. Once there, he vigorously promoted his plans, and brought the German farmer to his viewpoint and taught him how to apply science to farming. This farm, which had really become a demonstration farm, was the gathering place of many men in quest of agricultural knowledge.

Albrecht Daniel Thaer's mind was immensely productive. He contributed voluminously to agricultural literature, wrote text books on a variety of farm subjects, proposed a soil classification, introduced soiling or stall feeding of cattle, promoted vigorously the growing of red clover and other legumes.

In his gardens at Celle he conducted numerous breeding and hybridization experiments, and his insight into the nature of the processes of breeding and selection seems to have been truly remarkable; in some of his deductions he was fully abreast of our most modern views. He knew well the value of fortuitous variations and the part they play in the origination of new varieties. He very minutely describes in one of his publications a method of breeding through selection to secure constancy of type. He conducted breeding experiments with the view of learning the behavior of the awns of small grains, their variation and constancy, and the possibility of removing them by breeding.

HEREDITY AS A FACTOR IN THE IMPROVEMENT OF SOCIAL CONDITIONS[a]

H. E. JORDAN
University, Virginia

Those of you who have followed recent thought respecting human society will readily assent to the statement that there appears to be urgent need for improvement. Perhaps some of you in following the

[a] Abstract of address delivered by Dr. H. E. Jordan before the Virginia State Conference of Charities and Correction, Charlottesville, Va., May, 1910.

discussions concerning jails, insane asylums, almshouses, hospitals, reformatories, and public schools have been aroused for the first time to a sense of something fundamentally wrong and unjust. If not even yet, then walk with me the streets of your own city—or any city, large or small, east, west, north or south—with discerning eyes and sympathetic hearts, and note the number of poor, sad, sick, crippled, feeble-minded human beings, and tell me honestly whether you think that all is well, and that you of health, hope, brawn, brain and means have done your full duty towards your fellowman, present and *to come*. What intelligent effort are you seriously making to render life a little less aimless in your small sphere of influence? Are you thinking of these matters at all, or are you simply thoughtlessly "drifting down the turbid stream of life and helping to make up the grand confusion"?

With criminality (Dr. Austin Flint), pauperism, degeneracy, idiocy, insanity, and the various forms of maladjustment apparently on the increase, it becomes incumbent upon the patriotic, and the strong and intelligent, and especially those in positions of trust, influence, and responsibility to use every means, to search every resource, to make any sacrifice, and to go to any reasonable extent to ameliorate, and if possible to eradicate, this human woe; and to save to the future race what long ages of evolution from brute to man, through a bloody struggle for existence, and the survival of the physically, morally, and mentally most fit, has painfully brought to pass. And every one of us can wield some little influence, the cumulative effect of which will bring us nearer the goal of a universally rational and joyous life.

Lest you doubt me still respecting the reality of widespread human misery, come with me hastily in fancy to the insane asylum at Petersburg and the State Hospital at Staunton, Va., the Eastern Penitentiary at Philadelphia, Bellevue Hospital in New York, the municipal eleemosynary institutions on Blackwell's Island, Hull House in Chicago, the dives of San Francisco, the slums of Boston, the cemeteries of this land crowded with infants' tombstones—and I might extend the list almost indefinitely—and tell me again whether you think that the ills of society are imaginary. Remember, also, that the number of the above institutions is increasing, and that their walls are ever filled, and that the ranks of their inmates are recruited anew every generation.

To emphasize still further the seriousness of the present social condition, before passing to a consideration of its cause and suggestions for improvement, let me cite a few facts based upon statistics.

And I shall have to speak in plainest terms. This is no time nor occasion for prudery; to shut our eyes to revolting conditions is nothing less than criminal. The conditions exist. Purity and strength and wisdom, allied with initiative, insistence, persistence, courage and patience, must grapple with the social monsters—vice, crime and disease, the enemies of race improvement. In the United States today 3,000,000 persons are constantly ill. About 10,000,000 are thus economically affected more or less directly. There are now living in the United States about 8,000,000 people—a number equal to the population of the State of New York—destined to die of tuberculosis, and about half that number of Bright's disease. About 50,000 persons die annually in the United States of typhoid fever—a condition which should no longer be listed among diseases, but rather among crimes. About 1 in 500 of population in Europe and America are epileptic; about that same proportion feeble-minded, i.e., about 150,000, and nearly as large a proportion insane. There are 14,000,000 male adults under the age of thirty in the United States, 5,000,000 of whom have venereal disease or its sequelæ. And, saddest fact of all, more than 75 per cent of the operations required for inflammatory diseases in women are said to be due to venereal infections. The hereditary effect in terms of weakened constitutions, congenital infections, sterility of otherwise noble stock—to say nothing of the physical and mental anguish entailed—is appalling. There are in the United States 110,000 blind persons, about 25 per cent of whom owe their blindness to venereal disease; and about 50,000 deaf persons. Hereditary syphilis is said to claim a mortality of from 60 to 80 per cent. In France 20,000 children, or $7\frac{1}{2}$ per cent, die annually of syphilis. In the United States about one-third of all children born die before the fifth year. There are, besides, 80,000 prisoners and 100,000 paupers. In fact, about 5 per cent of our population is seriously defective in some form or other.

I regard this problem of human welfare (really the problem of race improvement) as the cardinal interest of the day. Despite her mines and waterways, all her forests and fertile fields, her navy and her hoards of gold and silver, this nation is rich only in proportion to the health and abundance of her potential fathers and mothers. The only real wealth of this country, or any country, is her citizens. If they be generally poor or sick or feeble or distressed, the nation is decadent and must disappear in spite of material assets. I take it that the most vital concern of this nation is the health of her people. "The health of our pigs has representation in the Cab-

inet, but not our children," says Warbasse. God cares no more for us than for other nations. Unless we would follow the fate of Assyria, Persia, Babylon, Egypt, Greece, and Rome, we must bestir ourselves and apply sane scientific principles to the treatment of our social ills. Dr. G. A. Doren, of the Ohio Institute for Feeble-Minded Youth, warns us that, "Unless preventive measures against the continuously progressive increase of defective classes are adopted, such a calamity as the gradual eclipse, slow decay, and final disintegration of our present form of society and government is not only possible, but probable."

I propose to consider, then, criminality, degeneracy, insanity, and sickness and early senility from the standpoint of heredity. It will be my effort to impress upon you the thought that criminals and degenerates and weaklings are born, just like poets, and not generally made by their environment. I believe I shall be able to show you that insanity is heritable and that feeble-mindedness and epilepsy sustain an etiological relationship to drunkenness. And the evidence is overwhelming that many forms of disease, or a predisposition or susceptibility thereto, at least, are traced from ancestor to offspring.

If it can be shown—and there seems little doubt on this point—that many types of human defect are heritable, the prevention of a steady quota of deficients is well within our power if we will. The positive aspect, of course, pertains to the inheritances of good qualities and plus racial characters. Where doubt exists or where proof is not yet conclusive, government aid could do inestimable service—and only so can the disputed points be quickly and at the same time accurately settled.

All life is conditioned by the same fundamental laws of nature. It would seem, then, that the same methods that man now employs in producing a high quality breed of dogs, or birds, or cattle, or horses, he must apply to himself. What inherent indignity to man is there in this thought? Whence and by what authority is it given that man can violate with impunity the laws of heredity as regards the reproduction of his own kind, but must adhere to them in the rearing of live stock? Why is the subject of race culture tabooed in so-called polite society? There is no issue so vital to this nation today as the rearing of the human thoroughbred. Whence this idea of impurity about this most vital interest of this people, except from the impure or possibly misinformed minds of perverted natures? St. Paul reminds us that "to the pure all things are pure."

It would be extremely interesting and might prove very instructive to trace the origin of the idea so intimately associated with our reli-

gion that the body is inherently base, that it must be "mortified," that it is something to be despised, that only as the body is neglected can the soul arise. I know not whence this idea. I know only that the author of our religion said that He came that "they (His brethren) might have life and that they might have it more abundantly." True Christianity gives no warrant for this exaltation of a weak and listless body.

It is just possible that much of the admitted loss of grip of the church on the conduct of virile men is due to the fact that religion today is shaped too much to make its especiai appeal to the sick and unfortunate—too much of its assumed authority issues from mental and physical weakness. I hope I may not be misunderstood here as to my feeling regarding the efficacy for good of religion. It is unmistakably one of the greatest moral forces in existence. But I hold that the healthy man can best express the highest type of religion. We want religion to appeal to strength and to health—and we want it to help in the effort to restore racial health, somewhat perhaps as the Emmanuel movement, in a very small way, in its inception. Religion to appeal more universally must become suffused with modern biological teaching. It must exalt health and bodily vigor more as something to be prized and respected. Its new spirit must teach that it is as important a matter to observe strictly the laws of personal hygiene as to say prayers. Perhaps when the span of life shall have become lengthened preparation for the ministry will embrace medical training and the physician's calling theological instruction. At any rate, we may expect religious teaching to take more serious and intelligent note of the laws that underlie life and the making of life and perhaps teach right conduct toward the future race as a part of the morals of religion.

Right-minded men are not willfully bad. Ignorance is at the root of much so-called vice and crime. An intelligent understanding of the laws of heredity and reproduction would do more toward minimizing vice than much impersonal religious teaching. The public schools also can do a splendid work here in dissipating harmful ignorance and foolish sentimentality by giving well-planned courses in botany and zoölogy.

It is an established fact that the degenerate class are more prolific. The fecundity of the irresponsible is frightful. Under such circumstances the deficient types will swamp the better types and thus lower the human standard and the general level of our civilization.

To return after this slight digression to the condition of our main interest: Any living thing is the product of an interaction between its inheritance and its environment. A discussion of the relative values in development of heredity and environment would be senseless. Both heredity and environment are essentials; essentials cannot be compared. The best stock of inherited qualities in an unfavorable environment produce nothing; nor can an ideal environment produce anything without a germ of life representing an inheritance. A noble man is not born from fools, no matter what the environment provided. Figs do not grow on thistles nor grapes on thorns in any environment. A feeble-minded child cannot develop into a great scholar even in an ideal environment; and, vice versa, or e inclined by heredity toward the life of a scholar cannot become such in an unfavorable environment, nor can one born an athlete excel in sports if bred in an environment that does not call forth the exercise of his talents.

I do not want to rob the human heart of the commendable virtues of pity, sympathy, and charity. I do not want to see done anything less than we are now doing for the comfort and happiness of our defectives of various types. I want to see material conditions improved for all classes alike to the highest degree possible. But for the sake of the future race, for the sake of the light entrusted to our civilization, out of respect and honor to our intelligence and good sense, let us have the courage to recognize our duty and forbid parenthood to the proved, and universally admitted, unfit. We speak of improving the condition of the jail, almshouse, insane asylum, etc. That is well. But don't you see that their inmates continually pass out, while their places are continually taken by new recruits? What I hope for is a condition where jails and asylums and charitable institutions are unnecessary. And I hope I shall be able to show that such a desire is not as quixotic as it may at first appear. These public institutions are a fearful drain—the more so because unnecessary—upon the national resources. They represent, moreover, a waste of much valuable time and effort. Our 42 institutions for feeble-minded cost us $5,000,000 annually; our 350 hospitals for insane, $20,000,000 annually; our 1,300 prisons, $13,000,000 annually; our 1,500 hospitals, $30,000,000 annually; our 2,500 almshouses, $20,000,000 annually; and our 115 schools and homes for deaf and dumb, and our 1,200 refuge homes, cost us many millions more annually. ("Eugenics," Davenport.) The time is fully ripe for at least negative eugenics—i.e., the prohibiting of parenthood to the unfit.

I am not yet persuaded that recourse to surgical procedure is the best alternative, except in most extreme cases of hereditary degeneracy; but I do advocate—and there can be no objection to this measure—that the inmates of our institutions for deficients be detained, no matter what temporary improvement they may show, until after the procreative period. This much at least is clear: that to be permanently rid of deficients, they must be prevented from reproducing their defective kind. Our only hope for racial improvement lies in prohibiting the continual replenishment in frightful numbers of our degenerate and criminal classes.

Professor Irving Fisher predicts that "laws like that of Indiana, but of gradually increasing severity, will become quite common in the future;" and Prof. Ray Lankaster has remarked that "humanity will probably submit in the future to communal restricting of the right to multiply with as good grace as it has given up the right to rob and to rape." The possibilities of applied eugenics are indicated by Prof. Louis R. Ehrlich, in the statement: "How rapidly the race would advance if mankind should resolve 'the next generation must be born with healtby bodies; must be nurtured in healthy physical and moral environments, and must be filled with the ambition to again give birth to a still healthier, still nobler generation'" (p. 54 of Prof. Fisher's report). Note also the sad commentary of our business sense— not to mention our moral sense—in the words of Dr. Prince Morrow of New York: "The extermination of social diseases would probably mean the elimination of at least one-half of our institutions for defectives." "So definite and certain is the result of the marriage of two imbeciles, and so disastrous is reproduction by an imbecile under any conditions, that it is a disgrace of the first magnitude that thousands of children are annually born in this country of imbecile parents, to replace and probably more than replace, the deaths in the army of about 150,000 mental defectives which this country supports." ("Eugenics," Davenport, pp. 14–16.)

Criminals, paupers, degenerates, the incurably sick and their kind are a serious burden—in cases even a menace—to society. Society has a right, even an obligation, to protect itself. The course of action is clear to the extent that in cases of undoubted ability to transmit defects such transmissions must be prohibited. Public sentiment will do much in this direction. Proper instruction will help; here as elsewhere, knowledge is power. Moral suasion on the part of the church and social institutions (lodges, etc.) will not be without reward. Courses in heredity and applied eugenics in our

medical schools and training schools for social service are urgently demanded. A national department of public health, from which may issue the results of scientific research and mature reflections—and which would coördinate all the branches of social service—is indispensable. And it is especially demanded that every one do his share of serious thinking and have the courage to act positively or negatively in the interests of the future race; and where all other means fail of appeal, law must enforce eugenic conduct.

The means of race conservation and improvement—the prime end for which social conditions are sought to be improved—seem clear. Simple observance of the laws of heredity and enforcement of eugenic principles would cure many of our social, political, and economic ills. What sanitary science and hygiene seek to accomplish by attention to external conditions alone largely defeats its own ends by counteracting the working of the principle of selection. Moreover, this is a tedious, long-drawn out, painful process. Rigidly applied eugenics would accomplish the end in several generations. The resulting healthy, happy race would require, and, indeed, could compel a still more purified environment. Contemplate this ideal state of human society! Thoroly healthy bodies could develop the highest ranges of mer tal capacity. There would be little suffering, weakness, sickness, crime, or vice. Individuals showing such tendencies would be treated with more than ordinary kindness and solicitude, but they would be denied the opportunity of reproducing their kind.

Flourence, a French scientist, who has given much attention to the question of old age, holds that an animal ought to live—and may live—five times as long as its period of growth. The natural lifetime of a man should thus be 125 years. Metchnikoff, another French scientist, also believes that there is no inherent necessity in human protoplasm to die short of the century mark. It may be a legitimate question to ask whether long life is really desirable. I believe it is, and, more than this, I believe that human progress in the perfected society above pictured necessitates a longer life. Even today it takes a man from 25 to 30 years to really prepare for life; and the stock of formulated knowledge is ever increasing. There remains too short a period for the use and development of this knowledge, and for the satisfactory exercise of one's powers and the proper rearing of one's kind. Few men ever naturally come to the sense of yearning for death as a boon—i.e., as the natural end to a satisfied life. To quote from Metchnikoff: "Old age, at present practically a useless burden on the community, will become a period of work valuable to the com-

munity, as the old man will no longer be subject to loss of memory or to intellectual weakness. He will be able to apply his great experience to the most complicated and the most delicate parts of the social life." ("Nature of Man," p. 295.) We may predict that when science occupies the preponderating place in human society that it ought to have, and when knowledge of hygiene (and, the writer may add, heredity) is more advanced, human life will become much longer and the part of old people will become more important than it is today." ("Prolongation of Life," p. 226.)

In the race that lives according to natural law and by eugenic principles, birth and death and their attendant pains and sorrows will not be permitted to follow each other in such quick succession. There will be less quantity and better quality. There will be no such ruthless wastes of human effort and strength as now prevail. To be parent to five children, for example, and bring only one to normal maturity, will be accounted criminal to *some one*. This may seem utopian. None of us will live to see this day. But by all the signs of the times, this day is coming. What seems certain is that it ought to come—and come it will as one of the sequelæ to proper social conduct. And it behooves us as intelligent, moral men and women to do our share and add our quota to hasten the time of this life more abundant in this kingdom of heaven on the earth.

CLASSIFICATION OF THE HORSE

PERCIVAL HICKS

North. Virginia

I propose in this paper to discuss briefly that classification of the horse which seeks to show that our modern horses are derived from four distinct species, a conclusion with which I cannot agree, and to set forth my reasons for dissent.

In dividing the existing breeds or families of horses into four species distinguished from one another by slight anatomical differences, and assigning to each a more or less clearly defined geographical area I think scientists have lost sight of much valuable information which has quite as strong a bearing upon the question, as those peculiarities which are regarded as distinctive. To clear the way to a discussion of this question I will at once introduce a diagram of the classification mentioned.

PREJEVALSKY HORSE

1. Callosities on all four legs.
2. Cat hammed.
3. Head set at right angles to the neck.
4. Red-brown in color with "mealy" nose.

CELTIC HORSE

1. No callosities on the hind legs.
2. Black stripe down the back and across the shoulders.
3. Sometimes transverse bars on the legs.
4. Dun color common.

FOREST HORSE

1. Head long and narrow, and set at right angles to neck.
2. Eyes recessive.
3. Has in common with the foregoing generally 6 lumbar vertebrae.

AFRICAN OR ARAB HORSE

1. Head set at an obtuse angle to the neck.
2. Slight difference in the development of the ulna.
3. Has only five lumbar vertebrae.

It would seem from a study of the foregoing that the first and most important distinction is the number of lumbar vertebrae. If it can be established that the present run of horses in use in Arabia and Northern Africa have in all cases only five lumbar vertebrae while other races have six, a large and well defined division would at once be established, but I would very much doubt whether this has ever been sufficiently proved to warrant its universal application and furthermore, I doubt the wisdom of establishing a species upon anatomical differences so subject to variation as the number of vertebrae in the lumbar region. The number of the lumbar vertebrae vary more largely than those of any other part of the spine (except of course in the coccygeal region), as the accompanying table taken from Chauveau's *Comparative Anatomy* will show.

Species	Number of Vertebrae				
	Cervical	Dorsal	Lumbar	Sacral	Coccygeal
Man	7	12	5	5	4 to 5
Horse	7	17 to 19	5 to 7	5	12 to 18
Ox	7	13	6	5	16 to 20
Sheep	7	13	6 to 7	4	16 to 24
Goat	7	13	6	4	11 to 12
Pig	7	14	6 to 7	4	21 to 23
Dog	7	13	7	3	16 to 21
Cat	7	13	7	3	21

A study of the above brings out quite clearly that, excepting the tail, the lumbar region is more prone to variation in all domestic animals than any other part of the spine. The horse it is true presents a variation in the dorsal region as well, for there the number has a range of three bones exactly as has the lumbar region, and I think that all anatomists will agree that the variations are generally complementary, that is where we have only five lumbar we find nineteen dorsal or seven and seventeen, respectively. The second anatomical distinction is the presence or absence of callosities upon the posterior limbs.

To those unfamiliar with anatomy I would say that these plates are comprised of epithelial cells arranged in microscopic tubes like those of the horn or the hoof, and are located at the upper extremity of the inner surface of the metatarsal bone. There is also a similar growth of corneous substance growing from the skin of the fetlock. The callosities are always, where present smaller on the posterior limbs, and are supposed by anatomists to be the remains of a prehistoric "thumbnail," in process of elimination by disuse in the course of evolution. As in the first instance I question the wisdom of basing a classification upon a variable character. I now question the wisdom of depending upon the presence or absence of a useless character in process of loss by evolution; for arguing from analogy one would expect to find the callosities eventually gone from all the limbs, if we could see far enough into the future, and during the process one would not expect such a character to be lost in one decade or even one century, but rather that it should first grow smaller and many times appear and disappear before the tendency to reproduce it should be entirely bred out.

The absence of the callosities from the hind legs of certain tribes of horses would in my mind clearly indicate a different environment for many generations and if one chose could make the distinction a difference in race or breed, but hardly a difference in species involving the existence of two parent forms.

The third anatomical distinction is the angle of articulation made by the head and the atlas vertebra, which it is asserted is dominant (in the Mendelian sense) when an animal so formed is bred upon one whose angle of articulation is obtuse. This seems to me a very slight distinction upon which to base a division of species unless it is well supported by other unrelated differences. The fact of its being dominant in cross breeding has no bearing upon the case for it is well known that many, in fact one might almost venture to say most,

abnormal variations are dominant when they occur within a well recognized breed which is much more restricted than the species. Indeed were it otherwise it would be difficult to understand how any variation could be inherited. For when it first appears it must be confined to one lone individual with all the accumulated inheritance of every other individual of the race against it. Should a variation be recessive it is hardly possible to see how it could establish itself unless it gave to its possessor some marked advantage in the struggle for existence. That such would be the case in a horse whose head was at an obtuse angle compared with one whose head set at a right angle to the neck is hardly conceivable for it is well known to all horsemen that no horse has any appreciable difficulty in grazing no matter what the set of its head may be. The long legged short necked foal does find some little trouble for the first few months of its life but not enough to in any way hinder its growth. To take up the other side of the question and decide whether or not the set of the head at right angles to the neck is of any advantage to the so-called forest horse is idle, for he would graze on leaves no matter how his head was articulated. But so far as my observation goes no horse willingly eats the leaves of trees, if grass is available, and I do not believe any breed of horses can exist if confined to woodland where there is no grazing; or that any species of horse in any way connected with those of the present day ever made a living from the leaves of trees or shrubs. All those animals which live on browse have a long pliable upper lip combined with the absence of the upper incisors; an anatomy and dentation so distinct from the genus equus as to warrant not only a difference of species but one of genus as well.

The fourth distinction, that of color is the most unsatisfactory of all. What was the color of the original progenitor of the horse no one has been able to ascertain, but it is generally well known and universally admitted that the variation of color under the influence of domestication, augmented as it has been, by the personal preference of individual owners, is so great as to preclude any intelligent reasoning.

There are dun horses in all countries and in most breeds, and there are red-brown horses with "mealy" noses in all countries and in most breeds, and no distinction of species can at this time be established by the presence or absence of any one color.

To sum up the situation I would say that any theory of a prehistoric horse that is plausible will find some adherents. But no theory should be accepted which is not thoroughly in accord with the facts

recorded in written history. When the historic period commences, speculation ceases, but to meet our own good acceptance, the speculations of antiquaries should dovetail into the facts of written history with complete accord, if any premises fails to do this it should at once be discarded or at least so much of it as fails to meet the requirements. At the very dawn of written history we have this one fact strongly brought out by the kind of negative evidence only possible in such cases. There were no horses known to the early Egyptians. When Abraham and Sarah visited that country about 1900 B.C. the reigning Pharaoh at once appropriated Sarah for his own sole use and benefit and in return made Abraham many valuable presents. In fact the truth seems to be that Abraham sold his wife for a little of most everything the country produced that would be of value to man, but there were no horses in the catalogue.

The first mention we have of horses in Egypt was during the reign of the Shepherd Kings, while Joseph was Prime Minister, and the inscription upon the monuments first contained horses at just about that date—1720 B.C. Egypt was at this time by far the richest and most civilized country bordering upon the Mediterranean Sea and I think it is fair to conclude that what was true of Egypt was true of the rest of Northern Africa. There was no material commerce recorded prior to that of the Phoenician merchants about 1000 B.C. and horses would not be carried to Northern Africa by land without crossing Egypt.

It would seem then that there was no species of horse indigenous to North Africa and the same thing is true of Arabia. Therefore, any classification which includes an Arabian or North African species must in that respect be faulty. My own opinion is that all our horses were descended from one wild species, and that while differences of environment had probably produced some wild established types prior to the dawn of the historical period the greatest variation occurred after domestication, and probably during the last few centuries. We have written evidence to show that there were several recognized breeds as early as the 12th century but I doubt whether the differences were as great as those presented by the various breeds of the present day, either in size, speed, or mode of locomotion.

We have abundant historical evidence to show that the extreme types of our domestic poultry, and many breeds of pigeons, are of very recent origin, and in regard to cattle and sheep we find the same to be true. The Shorthorn and Hereford and Delano Merino and Shropshire have all been developed in what geologically speaking

are recent times, and many of the fancy breeds of dogs are of quite recent origin although they now breed true to type.

In view of these marked peculiarities among the different domestic animals most of which are admittedly derived from one species, it is well to pause and carefully consider the ground before we accept the existence of four species of horse upon evidence established by differences less marked than those presented by the differences in the breeds of other animals.

THE PLANT BREEDING PROBLEM

ROBERT GAUSS
Denver, Colorado

The problems of dry farming fall easily into two classes. The first, probably the most important, embraces all questions pertaining to tillage and conservation of moisture. The second includes the procurement of plant species so adapted to aridity that they will produce profitable crops without irrigation under climatic conditions like those which prevail over the greater part of what is called the arid region of this country. If it were possible to find valuable plants of this kind growing in other countries, this part of the dry farmer's problem would be simple. All that would be needed would be to introduce or naturalize those plants in the arid parts of the United States. Little adaptation would be required, for, growing under arid conditions elsewhere, plants of this kind would already be acclimatized in nearly every particular to the Far West. But no species of agricultural plants fully acclimatized to aridity have been found. Hence the problem of procuring them resolves itself into the question of acclimatization. I have spoken of introducing foreign plants, if any already adapted to aridity were known. This is called naturalization. Acclimatization is radically different; and it is so much so, that some naturalists have been inclined to doubt if there is any such thing. It involves so great a change in the constitution of a species that it would thrive under climatic conditions radically different from those of its original home. Professor de Vries is one of those naturalists who seem to doubt the efficiency of any attempt at acclimatization, and yet of all writers on this and kindred subjects with whose works I am at all familiar, he has contributed most to the solution of the problem. Darwin says: "I am aware that the attempt to acclimatize either animals or plants has been called a vain chimera. No

doubt the attempt in most cases deserves to be thus called, if made independently of the production of new varieties endowed with a different constitution." In the light of what de Vries has said about the production of new elementary species, I should substitute "species" for "varieties" in the foregoing quotation from Darwin and then say emphatically that an attempt to complete acclimatization from a humid to an arid climate is a vain chimera, if made independently of the production of new elementary species endowed with a different constitution. It is at this point that de Vries comes to the rescue and provides a way of escape from the fate which he seems to think awaits attempts at acclimatization. When Darwin wrote, little was known about distinctions like that which de Vries makes when he speaks of "elementary species." But this distinction must be recognized, for it lies at the foundation of all rational attempts at acclimatization. In the light thus thrown upon it, acclimatization is seen to be the development of a new elementary species, which by reason of its peculiar constitution will thrive under the new climatic conditions.

In an effort to show that there is no such thing as acclimatization, de Vries cites the case of certain annuals which thrive upon the desert during the rainy season. He says that in many respects they present the typical appearance of desert plants, but that when grown under conditions of abundant moisture, they lose their desert character and thereby demonstrate that their supposed acclimatization is not real. Many illustrations of a similar kind are presented by the flora of our arid region. There are numerous little annuals growing on the arid and semi-arid plains which have a range extending to the Atlantic coast. In other words, neither these nor those spoken of by de Vries are true desert species. They grow in desert countries only during the rainy season, at which time the climate is humid and not arid. Growing only during a brief period of abundant moisture, there has been nothing in the history of the species which might, through natural selection, have produced a complete adaptation to the desert climate, instead of merely a seasonal adaptation to a brief period of abundant rain. It is not strange that plants of this kind lose their desert appearance when grown in a humid climate. It would be strange if they did not do so, for they are true mesophytes, never having acquired or possessed a true xerophytic constitution.

An adaptation of this kind may be seen in many varieties of wheat and other cereals which make a more or less profitable growth on the semi-arid plains, but which depend largely upon whether it is a wet

or a dry season. Something more than this is requisite if a species completely adapted or acclimatized to aridity is desired.

This takes us back to the position that what is needed is the production of a new elementary species which will breed true in its drought resisting characters and in everything else.

At this point the problem undergoes another division into two branches. One involves the production of the desired elementary species through cross fertilization and whatever hybrids may be produced in conformity to the Mendelian law. The other has to do entirely with selection, and it is to this particular branch that I have directed nearly all my thought on this subject and practically all my efforts to attain the desired end. It may be questioned whether there is any real breeding of elementary species by this process, for, after all, it is rather a matter of finding the desired exceptional individual, rather than producing it.

I say that it is rather a matter of finding than of producing the desired species, for, again following the lead of de Vries, I am convinced that, if ever found, the looked for individual will be seen to be the result of a mutation in the desired direction, hence practically a new species. In an earlier paper on this subject, I stated that when I began experiments in breeding drought resistant cereals, I thought the desired end might be attained by adding one favorable variation upon another from season to season. But I was not long in discovering that I made little progress. A favorable variation in one year might be completely lost in the year following by a variation in the opposite direction. While working in that way, my efforts were entangled in the meshes of fluctuating variations. Like a pendulum my experiments swung from one side to the other of the narrow range over which fluctuating variations extend. Here again de Vries showed the way of escape. In discussing the evolution of species, he shows that mutations or radical changes in the structure and character of plants may occur in the life history of a species, that the mutations overleap the narrow ranges of fluctuating variations and thereby establish a new elementary species. Entirely free from the entanglements of the old fluctuating variations, this new species continues along its new lines, breeding true and reproducing the new characters as faithfully as the old were reproduced before the mutation took place.

Because of what he has said about fluctuating variations and the development of elementary species through mutuation, I claim that de Vries has shown the possibility of achieving the acclimatization

which in other parts of his writings he seems to try so hard to show is a chimera. That he thinks that in the case of wheat, new elementary species are of frequent occurrence, is shown by his declaration that in his opinion the improvements made by Hays in the wheats of Minnesota were due to the development of new species of an elementary kind. I also think they are of frequent occurrence.

To avail oneself of mutations in the development of drought resistant species, one must look for mutations in the direction of drought resistance. This is why I said it is a matter of finding rather than producing the desired species. It is evident that the greater the number of plants subjected to examination, the greater the probability that the desired mutation will be found. Under this theory, every field of wheat grown on a dry farm becomes an object worthy of careful examination. For the encouragement of persons engaged in this search, it is well to recall the fact that Sheriff, the famous English discoverer of new and valuable species of wheat, achieved his great results by examining the wheat fields of the neighborhood in which he lived.

All experimental breeding with reference to the acquisition of drought resistant species by selection should be conducted upon as extensive a scale as possible. Little can be hoped from the cultivation of small plats or beds of wheat containing a few hundred or even a few thousand individual plants. The plants should be grown far enough apart to admit of the careful examination of each one separately. But they should be grown not by the thousands but by the hundreds of thousands. The work should be carried on at every experiment station in the arid region, whether under state or under federal control. Out of the need of widely extended work of this kind has grown the project for the establishment of a botanical laboratory at some central point which would be in easy communication with all parts of the arid region—embracing not Colorado alone, but all the arid states. Plants showing what might seem to be mutations of the desired kind might be sent to this laboratory for examination, and the seed from specimens shown to be valuable could be saved for replanting.

A bill prepared by me and introduced in congress last winter by Senator Guggenheim and Representative Taylor provided for a laboratory of this kind to be established in Denver, that city being more favorably situated than any other for close communication with all parts of the arid region. That bill contemplated extensive experiments of the kind I have outlined and designed to secure the adap-

tation of valuable species to aridity. It also contained a provision for similar experiments to be conducted on the high mountains of Colorado with a view to adaptation to low temperature. For this feature of the project I am indebted to Mr. Levi Chubbuck of the U. S. Department of Agriculture, who last winter made his home in Denver. He was especially interested in the development of Alaska agriculture, and he hoped that by experiments upon the high mountains of Colorado, valuable species might be developed which would be adapted to the climate of that far northern part of the national domain. Experiments of this kind like those designed to secure adaptation to aridity, would suggest the wisdom of establishing the proposed laboratory at some central point like Denver.

I am also indebted to Professor Ellsworth Bethell, the well known Denver botanist, for the suggestion which was subsequently embodied in a provision for investigations to be made in connection with the proposed laboratory into the plant diseases more or less common in this part of the arid region.

A well equipped botanical laboratory is an essential part of any extensive scheme of experiments designed to promote the acclimatization of valuable species, to aridity, and also to low temperature. But as it has not been my design to discuss at length this particular feature of the scheme, I think that what I have just said on that part of the subject will suffice. To restate the main points of my theory of plant breeding with reference to aridity, it is in my opinion essential to bear in mind that the problem is one of acclimatization; that its solution is to be found in the discovery or development of new elementary species possessing drought resisting character; that those elementary species are to be developed through favorable mutations, that in order to increase the probability of the occurrence of mutations of this kind the breeding experiments should be carried on upon as extensive a scale and at as many different places in the arid region as possible; that every dry farm field should be searched for plants possessing the desired character; and that by the maintenance of a botanical laboratory at some central point, means would be provided for the examination and study of promising plants which might be found growing on dry farms or at an experiment station in any part of the arid region.

Finally, I have this to say to all dry-farmers: Plough deep, stir the surface of the soil, conserve the moisture, use none but acclimatized seed, and time will prove that this early settlement of dry-farmers is but "the first low wash of waves where yet shall roll a human sea."

DOMESTICATION AND ACCLIMATIZATION OF WILD MAMMALS

D. E. Lantz
U. S. Department of Agriculture, Washington, D. C.

The steps by which man rose from the savage state and attained his present degree of enlightenment are marked by the progress he made in domesticating animals and plants and subjugating them to human uses. Could we fully know the history of our domestic animals it would enable us to understand the processes by which the races of men came to the mastery of things about them. Primitive man must have especially lacked forethought for future seasons, and it is possible that he first acquired it through the necessity of making provision for the animals which he possessed.

After primitive man had taken a few steps in domesticating wild animals and when he saw that the results had contributed to his comfort and happiness, he had a strong incentive to further achievements in taming other animals and plants. The process of domestication went forward slowly until he had tamed all the animals and plants we now have in possession. Man has been uplifted by the process as well as by the results. His association with lower forms of life in domestication has enlarged his sympathies for all life and has the better fitted him for intercourse with his fellows.

And yet comparatively few of the higher and more useful forms of animal life, mammals and birds, have been domesticated. Of about 5,000 species of mammals now inhabiting the world, only about 25 may be said to be really serving man as beasts of burden or furnishing him with food, clothing, or companionship while in a state of dependence upon him. Of birds, the proportion of domesticated species is even smaller. No important increase in the list of animals under domestication has been made in the last five hundred years. In the plant world, on the contrary, the last few centuries have witnessed a wonderful development of new forms under domestication.

The preceding statement is not meant to imply that our domestic animals have been neglected. Most of them have been plastic in the hands of breeders, their value has been greatly increased and will be still further enhanced as the years pass. Nor have agriculture and commerce alone benefited from the study of our domestic animals. Science has been equally enriched. The influence upon the doctrine of evolution and theories of heredity and sociology can not be overestimated. Comparative anatomy, embryology, physiology, hygiene,

and preventive medicine have all been enriched by the study, and practical surgery owes its progress in large measure to the knowledge gained from investigations made with domestic animals. The mammals have afforded the best field for this research.

Several practical objects are to be attained by further efforts to domesticate wild mammals. Who will say that more beasts of burden would not benefit the world? The zebra and the African elephant may well repay their subjugation in their native land. Then there is the matter of conserving and increasing our supply of furs. The most rational expedient seems to be the breeding of fur bearers in domestication or partial domestication. This, too, presents the only means of preventing the loss of species through extermination. The extinction of the quagga and the blaubok from the South African fauna could easily have been prevented had forethought been applied to their preservation.

The charge has been made that the desire merely to preserve a species is sentimental and has no practical value. I maintain that in this matter both sentiment and economy are worthy of consideration. A large number of the species that have come under human control were first tamed solely for the pleasure they could afford their possessors. This is true especially of flowering and other ornamental plants and of some animals, as, for instance, the canary. In a measure, this is always considered in the selection of species and individuals for breeding, and it must have a marked influence in deciding the fitness of wild species of mammals for domestication.

From the economic standpoint, the strongest argument for attempting to breed wild mammals in captivity is the production of food for the human race. The American pioneer found a great variety of game in our forests. But this source of food has diminished until few can avail themselves of it, and we are coming to a time when the production of game in preserves is the only way to have it. Yet our aim should be not so much to furnish more game for sportsmen as to provide a greater variety of food for the people.

Two sources of additions to our present list of domestic animals are possible. The first, and the more desirable, is to select from our native species of fur or game animals. These require no preliminary experiments in acclimatization. The other plan is to bring in exotic species. The selection of a foreign species for introduction and experiment must depend on a similarity between its natural and the proposed habitat or on its probable adaptability to the new surroundings. This adaptation may sometimes be judged from the history of former

attempts to acclimatize it or its near relatives. For this purpose the experience of zoölogical parks becomes helpful. But in a country so large and so varied in climate as ours the same general principles must be considered before transferring a native species from one locality to another.

Of our native mammals, two kinds of deer have proved themselves adapted to every part of the United States and have done well in confinement under nearly all circumstances. These are the wapiti, which we miscall the elk, and the common white-tailed, or Virginia, deer. Both promise to become important sources of food and of great economic value. The other species of American deer seem to be less adapted to life outside their natural range. The same is true of the pronghorn, or American antelope. While the bison is apparently perfectly hardy in all parts of the country, it is doubtful if it could be made of sufficient utility, even if bred in large numbers, to take the place of the cattle which it would displace on some of the ranges. Its extreme hardiness is the chief factor in its favor. Yet in spite of the high value of buffalo robes, cattle raised on the same area would probably pay better than the bison. On the other hand, deer can be raised on areas unsuited to cattle and utilize much land now unproductive.

Of our native fur animals, several species are worthy of patient experiments in breeding them in confinement. The beaver, the otter, the black and silver foxes, the marten, the mink, and even the skunk and the muskrat present possibilities for the breeder who is also a patient investigator. Thus far success has crowned very few of the efforts to produce furs in captivity. It remained for a Belgian, one Johan Beetz, living in remote Labrador, to show that the common red fox when bred with black stock produces a preponderance of black and silver offspring. In five generations the red stock had given way to black; and, in a letter to the Department of Agriculture, Beetz claims that he has now purebred black foxes without apparent tendency of reversion to the red type. This would seem to show that the black is probably the ancestral form of our red foxes.

While our native species should have first consideration as subjects for experiments in domestication, many exotic species might be profitably acclimatized either as wild game or to be bred in captivity by our people. The list of species available is too great for more than general mention.

The Old World antelopes, members of the family Bovidæ, include many valuable food animals. In Africa there are more than a hundred species, many of them hardy and most of them excellent game.

Fully a score of species would be promising subjects for acclimatizing in America. Africa, like our own country, has arid sections, and some of her antelopes are probably especially adapted to the desert lands of our Southwest, and might be used to restock parts of that region from which our own pronghorn has been exterminated.

The eland (*Taurotragus*), the largest of the antelope family, is threatened with extermination over the greater part of its range in South Africa. Its average weight is from 800 to 1,100 pounds, and old males have been known to attain a weight of 1,400 to 1,500 pounds. This animal has often been recommended for rearing in captivity because of the excellence of its flesh, which is said to be superior to beef. Harris, the African traveler, states that while it resembles beef in grain and color, it is far better flavored and more delicate, possesses a pure game flavor, and is remarkable for the quantity of fat interlarded between the muscles.

The eland was introduced into Holland by the Prince of Orange in 1783. It was acclimatized in England by the Earl of Derby in 1842, and was bred successfully in his parks. After his death the herd passed into possession of the London Zoölogical Society in 1851, and continued to increase in numbers for many years. In 1899 the Duke of Bedford had a fine herd of 14 elands in the park at Woburn Abbey.

The scarcity of this game animal in a wild state and the consequent cost of obtaining stock would probably make experiments in breeding it in the United States prohibitive to individual enterprise. However, the experience with the animal in Europe gives assurance that efforts to acclimatize it in the United States would be successful.

The eland is only one example from a long line of exotic antelopes that might prove valuable in the United States. The deer family represents another equally important class, from which, besides the already partly domesticated fallow deer, there might be taken the sambar, the axis deer, the swamp deer, the Chinese water deer, the muntjacs, and other promising representatives. In suggesting the acclimatizing of these animals in the United States, we do not advocate their indiscriminate introduction nor the immediate release of any of them to resume their wild life. The history of the introduction of beneficial animals into new localities should teach caution in such experiments. Even species fully domesticated have become injurious when neglected and allowed to run wild. Devastations of crops by horses, cattle, pigs, and goats, introduced into new countries for domestic use and afterwards abandoned, have been known in many parts of the world. The destruction of native birds and mammals

by dogs and cats that have gone wild furnishes an equally valid argument for caution. Probably less danger attends the acclimatization and release of the class of animals under discussion than any other; and yet it is known that deer and antelope under certain circumstances have increased so enormously as to destroy important crops. Ordinarily should they prove injurious in the United States, the removal of protection would be followed by their speedy extermination as game.

The history of former attempts to acclimatize exotic animals in the United States is interesting. Fallow deer and red deer were successfully kept in some of the early deer parks of Maryland and Virginia. Washington kept both fallow deer and native Virginia deer on his Mt. Vernon estate. In recent years red deer have been introduced into some of our larger game preserves in America, but apparently have not thrived as well as our native species. A few years ago an organization of California sportsmen proposed to introduce gazelles in our Southwest, but thus far no importations have been made. The great camel experiment made by the War Department before the Rebellion has been regarded as a failure; but as an experiment in acclimatizing the animals it was really a great success, for they proved to be well adapted to our southwestern conditions. That they should prove unprofitable as army transports was an entirely different matter.

The alpaca experiments of sixty or seventy years ago were unsuccessful because attended by lack of judgment as to the localities suitable for the animals. For many years agitation was rife for a trial of the alpaca as a wool producer in northern latitudes. As early as 1840 alpaca societies existed in both England and the United States. A memoir on the alpaca written by a Mr. Walton was published in London and had wide circulation. Several wealthy men in England and Scotland imported the animals for breeding. Queen Victoria and Prince Albert in 1845 appeared in court robes made of alpaca wool grown in the park at Windsor. The largest shipment of the animals for the United States came from Aspinwall in 1859 on the brig *E. Drummond*. The total shipment was 71 animals, but 29 died during a severe storm and only 42 were landed in New York. Some were taken to places in New York state and New England, but it was soon found that the animals were equally unsuited to the humid climates of Great Britain and the Northeastern United States. Had they been introduced into the arid western country, they would probably have thrived as well as they do on the Pacific Slope of South America, their natural home.

The time for beginning experiments in the introduction of foreign food animals and for scientific attempts to breed our native game and fur animals in captivity has surely arrived. To delay them much longer is to permanently lose the opportunity for some. The well-located game reservations now existing, the government experiment stations, and the national parks afford the best of surroundings for the experiments. The men for conducting them can be obtained. The expenditures for stock, transportation, fences, buildings, and maintenance need not be a great drain upon either private or public resources. Only moderate appropriations would be required; but permanency of the establishment would be a necessary condition, for the problems are not of a kind that can be solved in a few years. A wild species cannot be domesticated during the life of a single generation of man. Yet the economic benefits from such experiments as I have suggested need not wait for the full domestication of a single species. Some of the advantages can be reaped within a decade after the experiments are inaugurated.

REPORT OF COMMITTEE ON HEREDITY OF FEEBLE-MINDEDNESS[a]

A. C. ROGERS, M.D.
Faribault, Minn.

During the past sixty years the care and training of feeble-minded children has grown from a small beginning, in a private residence in a New England town, to a point where approximately 19,000 of this class are cared for in about fifty public and private institutions in the United States. It has been a period devoted to extension and the development of a policy with regard to the class. Research concerning its etiology has necessarily received but secondary consideration. Its desirability has been recognized throughout, but financial support for it has not been forthcoming. In token of the recognized desirability of research, the institutions for the feeble-minded in this country have been, during this entire period, gathering such data as the parents, friends, and relatives of the beneficiaries of the institution would voluntaily furnish, either at the time of the admission of the latter or during interviews, as occasion afforded opportunity at various times afterward. These data have never been considered of very great value and have been used only to illustrate the large

[a] Read at the Columbus meeting of the Association, February 1, 1911.

percentage of defective, neurotic, or diseased ancestors of feeble-minded persons. For instance, the report of Dr. I. N. Kerlin on "Etiology of Idiocy" in 1880,[b] "The Ascribed Causation of Idiocy," etc., by the writer in 1884;[c] "The Causation of Idiocy and Feeble-Mindedness," by W. F. Wilson, M.D., 1894;[d] Statistics of Heredity," by Dr. J. C. Carson in 1905;[e] and "The American Table," by Martin W. Barr, 1904.[f]

The increasing comprehension of the magnitude of the feeble-minded problem gives rise to a demand for more accurate information as to its etiology. We are passing into a period when students of this subject can no longer be satisfied with the prefunctory reports of relatives, as exhibited in institution records.

The work promoted by Mr. Johnstone and Dr. Goddard at Vineland in this particular field and by others in this Association, in other fields, illustrates the perfect feasibility of the new method. Vineland, N. J., Lincoln, Ill., Faribault, Minn., and Glenwood, Iowa, have established their departments of research. In each institution, as at Vineland, the work will be divided between two interests: (1) Laboratory research, including psychological examination of children, and (2) field work, having for its object the discovery of hereditary conditions of an etiological nature. In the three institutions last mentioned, respectively, Dr. Huey, Dr. Kuhlmann, and Dr. Lange are devoting their time entirely to laboratory work, though the State Board of Control in Minnesota has asked for a special appropriation, which can be used for field work also. If this appropriation is granted, it will be for the use of all the Minnesota state institutions interested in the subject of etiological investigation. It is proposed to enlarge the present agency, which is now, under the law, devoting its time entirely to examining social conditions of patients and inmates who have gone out from hospitals for insane and the School for Feeble-Minded and Colony for Epileptics. The extension of this work to include the study of hereditary conditions will enable us to make a necessary and important beginning in this latter line.

The secretary of this committee, Dr. Goddard, who has been the pioneer in research work assigned to the committee, has given splendid illustration of the results of the field work. From the table

[b] Proceedings, Association of Medical Officers of American Institutions for Idiotic and Feeble-Minded Persons, 1880, p. 150.

[c] Ibid., 1884.

[d] Minnesota State Conference of Charities and Corrections, 1894.

[e] Fifty-fifth Annual Report, Syracuse State Institution for Feeble-Minded Children, 1905, vol. 1, p. 34.

[f] Mental Defectives, p. 94.

Summary of heredity lines of 187 families whose members are connected with inmates of Vineland Institution for Feeble-Minded January 27, 1911.

Series number.	Average mental age.	Total number families.	Condition {Heredity or mating.}	Immediate Family. Feeble-minded.	Normal.	Unknown.	Died in infancy, dead and miscarriages.	Total conceptions.	Whole Family. Feeble-minded.	Normal.	Died in infancy and miscellaneous.	Alcoholic.	Criminal.	Epileptic.	Insane.	Sexual pervert.	Tubercular.	Generations.	Total number tabulated.
1	7	12	F. × F.	44	0	13	14	71	124	109	93	8	3	1	7	12	9	4	522
2	7	9	F. × F. (plus)	28	0	5	10	43	130	57	63	12	4	2	1	17	14	3	321
3	5	2	F. × F. (ep.)	3	0	9	1	13	52	12	11	3	1	4	2	12	0	4	116
4	7	5	Ep. (plus)	13	3	14	8	38	60	22	50	5	1	7	1	6	8	4	202
5	5	13	F. male (plus)	19	14	17	23	73	62	165	142	13	1	2	2	7	25	3	591
6	6	33	F. female (plus)	72	17	29	66	184	250	190	433	64	10	3	6	31	66	4	1,289
7	5	47	F. M. heredity	75	47	34	106	262	161	577	569	44	0	12	19	13	61	4	1,978
8	4	6	Mongolian	6	21	0	6	33	10	131	145	1	0	1	1	0	2	3	205
9	5	60	Nor. heredity	60	165	46	82	353	60	962	578	43	1	5	15	24	49	3	1,983
10	3	21	Nor. heredity and N. × N.	21	88	8	31	148	21	490	228	5	0	1	4	11	11	4	823
11	..	21	F. × F. (matings)	66	0	10	12	88											
Summary of Series 6		121	Feeble-minded heredity	254	81	116	228	680	839	1,132	1,369	149	20	31	38	98	183	4	5,019
Summary of Series 5		60	Normal heredity	60	165	37	82	353	60	962	578	43	1	5	15	24	49	3	1,983
Summary of Series 1, 2, 3, 11[a]		44	Feeble × feeble	141	0	37	37	211											

Note—F. × F. = both parents feeble-minded, with no other defects.
F. × F. (plus) = both feeble-minded and one or both alcoholic or tuberculous or the like.
F. × F. (ep.) = both parents feeble-minded but with epilepsy.
F. male (plus) = father feeble-minded and mother normal mentally but one or both alcoholic, etc.
F. M. heredity = neither parent feeble-minded but feeble-mindedness found in the ancestry.
Nor. heredity = no feeble-mindedness to be found in family—(parents may be alcoholic, etc.).
Nor. heredity and N. × N. = parents free from alcohol, etc.
F. × F. matings = includes all cases where husband and wife are feeble-minded besides the parents of the child in the institution.
[a] The total of these three lines does not equal that of the column above, owing to the exclusion of duplicates.

which is presented here, it will be noticed that the Vineland force have reported on over 5,000 people as to their positions in hereditary lines connected with inmates of the Vineland institution, involving the study of 225 families.

It is unnecessary to dwell upon the details of these reports, which are presented elsewhere, except to note that, so far as the investigation has gone, there has been no instance discovered of a normal child resulting from the mating of defective parents.

The committee feels that the way is opening for large, interesting, and important results.

A COTTON VARIATION WITH A SELF-FERTILIZED ANCESTRY

SAMUEL M. BAIN
Knoxville, Tennessee

In the spring of 1906 the writer began a project in connection with the cotton-breeding work of the Bureau of Plant Industry, U. S. Department of Agriculture, to determine by accurate experiment the effect of northward or southward change of seed on the season of maturity of Upland cottons. For the starting point three varieties were chosen, viz., the Ramsey, a Louisiana variety; the Triumph, a well-known variety of Texas origin, and the Tennessee Greenseed.

It is somewhat fortunate that of the three most pronounced variations from progeny rows in the field, after some six years' experience in breeding Upland cottons, one should have occurred in a pedigree culture.

The Tennessee Greenseed is an old variety which a generation ago was apparently almost universally cultivated in Tennessee, and perhaps within the northern limits of Alabama and Mississippi. The stock used in these experiments came from the plantation of the late James Walker, of Lauderdale County, Tennessee, and grew within three or four miles of the Mississippi River. Mr. Walker had never during a period of thirty years permitted any other variety to be raised on his farm, and had used his own gin exclusively for his own crops.

A typical plant of this variety was chosen in 1905, and the seed was planted in a row on the farm of the Tennessee Experiment Station at Knoxville in the following year. It may be stated in this connection that, owing to the several climatic factors involved, the season

suitable for cotton growing is at Knoxville considerably shorter than at the Mississippi River, more than 400 miles west. From an experience of six years with the crop in both sections the writer has learned that there is a difference of fully three weeks in the time of safe planting of cotton seed between the two localities.

As stated, seed from the plant above referred to was planted in the spring of 1906. That year and each succeeding year flower buds were covered with paper bags and securely tied on the day before the blossoms opened. These bags were allowed to remain attached to the bolls for several days. Under favorable conditions a very large percentage of blossoms treated in this way have set perfect fruit. After four generations of self-fertilization there is no apparent deterioration of vigor in the offspring.

The only object of this experiment was to determine the effect of latitude and concomitant climatic factors on maturity. An effort was made to avoid any definite selection, though on the few days chosen for covering buds in midsummer naturally the plants having the larger number of flowers at the time were the ones most likely to be perpetuated.

No marked difference was observed in any of the progeny rows until 1910. Unfortunately, the difference that then came to light did not attract attention until after October 28, when all the plants were killed by frost.

On a subsequent visit to the plots, the astonishing contrast between three of the progeny rows and all the others was visible. Every plant in these three rows was stout, strict in habit, and at least a third taller than its cousins in the other rows. Moreover, the crop was quite late in maturing. This was shown by the fact that the short season had not permitted half as many bolls to reach maturity and open as in the other progeny rows. Both these points come out clearly in figure 1, which shows adjacent progeny rows, the left-hand row representing the variation. In fact, a casual inspection of the plots after the plants were killed by frost would indicate a greater difference between these two progeny rows, the self-fertilized descendants of one ancestor four generations back, than existed between any two of the original varieties with which the experiment began.

The relationship of these three tall progeny rows is shown in figure 2. The progeny rows marked E, F, and G, the ones under discussion, are shown to have come from three plants out of a single progeny row in 1909. This row must have shown some such indication in 1909,

but it was not observed or recorded, perhaps because of unfavorable conditions for the difference of habits of growth to become manifest.

In figure 2 is exhibited one seed from each plant grown in the culture of 1910 (except two overlooked by mistake). These seeds were taken at random, one from each plant, and are shown in a vertical row above each lettered circle indicating the twenty-three progeny rows of 1910, from A to X, inclusive. The seed in progeny rows E, F, and G, are seen to be distinctly larger than the average of those from the other rows, and exhibit a distinct tendency toward smooth-

FIG. 1

ness or absence of tuft. On inspection of progeny rows B, C, D, it was observed that the plants almost uniformly matured somewhat later than in the progeny rows A and H to X, inclusive. They also showed a slight inclination toward the slender habit of E, F, and G. For the origin of this mutation we are, therefore, to look back to the exclusive common ancestor of all six of these progeny rows chosen from the crop of 1907, as clearly indicated in the genealogical lines proceeding from that circle in the diagram shown.

It appeared to the writer as quite interesting that such a distinct variation should appear in a self-fertilized line. While the temptation

is strong to generalize on the results of such a phenomenon, especially in view of two other somewhat similar results obtained under field conditions with other varieties of cotton, the purpose at present

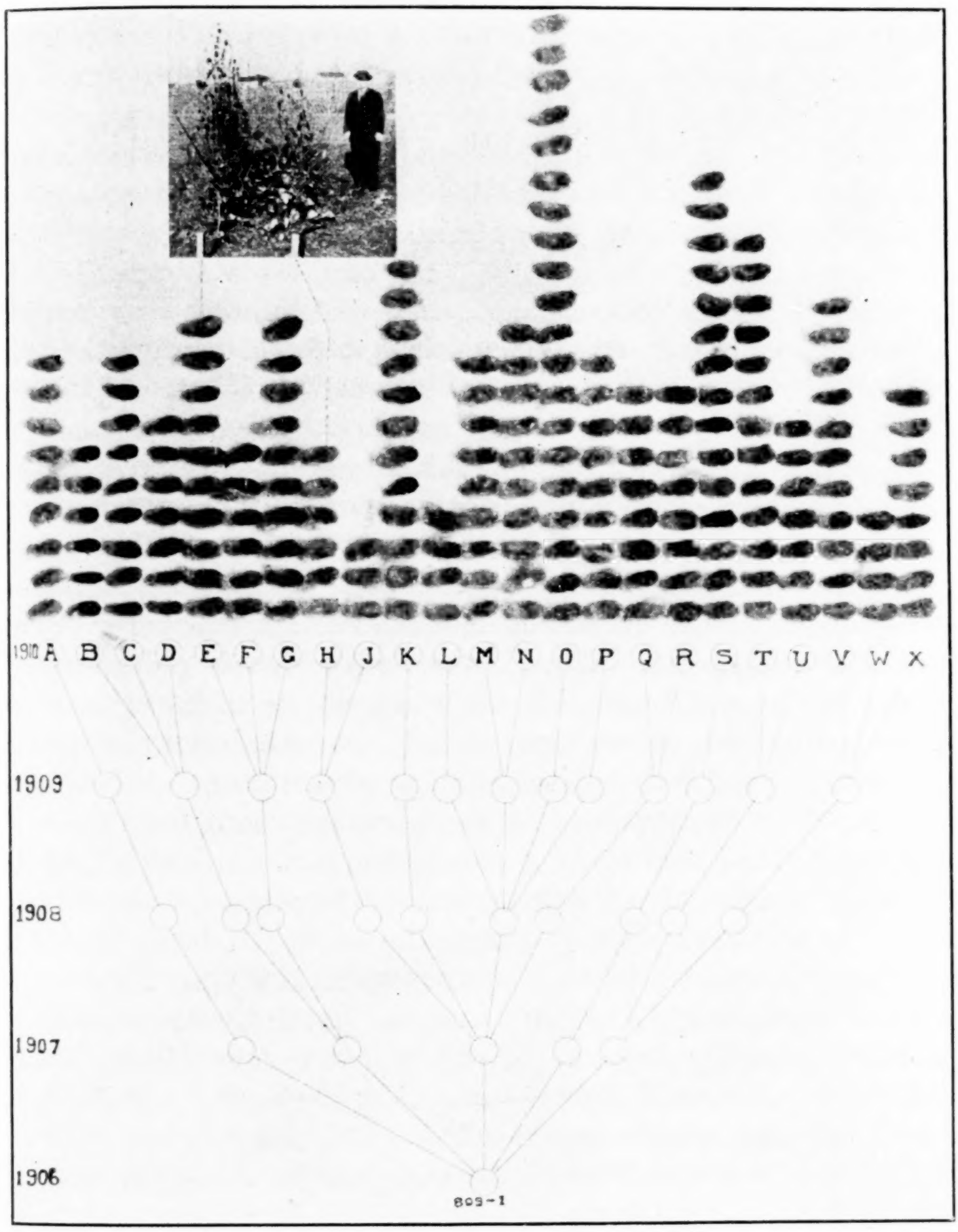


FIG. 2

is merely to record the experiment. Very similar variations from Triumph cotton are discussed by Mr. O. F. Cook, in "Local Adjustment of Cotton Varieties," Bulletin 159, Bureau of Plant Industry, U. S. Department of Agriculture, pages 20–25. These were the result

of transfer of seed from one locality to another, with a considerably smaller contrast of climatic conditions than the case cited in this paper. Much larger numbers of plants were used in the Texas experiments, but the seed had not been produced under conditions of self-fertilization.

HEREDITY ONE OF THE LARGE CONTROLLABLE FORCES[a]

HON. WILLET M. HAYS,
Washington, D. C.

Science has at last undertaken to organize the business of plant and animal breeding as it has organized mechanics. The world has come to see that the force of heredity gives rise to economic values just as truly as the force of electricity. The laws of heredity are beginning to be formulated by scientists as other investigators are building up the sciences which underlie mechanics. Breeders are devising methods for creating new values from the many domesticated species of plants and animals as other men are inventing machines. Breeders are creating larger values, in the form of larger yielding strains of corn, wheat and vegetables, again in the form of larger meat and butter production, or yet again in form of speed, beauty or strength in horses and combinations of form, color and fragrance in flowers.

None will be more surprised at the advances arising from the study of heredity than those who make a study of the purely physical sciences in relation to mechanics. The word *breeding* is no longer sufficiently comprehensive to designate the science of heredity and its practical application to the improvement of living forms. The broader word *genetics* has come into use, to signify man's activities in approaching the truth about this abstract force called heredity and also in utilizing the new knowledge in efforts to improve the types of plants, animals, and men.

The term "breeding," which was long used in connection with the improvement of domestic animals, is now applied quite as much to plants. The fact is that in the past decade plant breeding has overtaken animal breeding both in technique and in achievement of remarkable results, thus illustrating the rapidity with which genetic subjects are being taken in hand. And now that science has entered

[a]Condensed from an address before the American Breeders Association, Feb. 1, 1911.

the field of human descent, a third division of genetics has gained recognition under the name eugenics. Five years ago the first Committee on Eugenics was formed by the American Breeders Association; recently, by an almost unanimous vote, the Association changed this Committee to a Section of Eugenics, coördinate with the Plant Section and the Animal Section.

A whole category of new words is being provided to express the newly discovered facts and phenomena of heredity and the newly devised methods of breeding. A new literature is rising as a result of the discovery and elaboration of Mendel's laws, nearly as voluminous as the literature which grew out of the labors of Charles Darwin, and of even more definite character. Mendel and his followers promise to have as profound an effect in developing the science and methods of evolution by systematic effort as Darwin and his followers had in bringing the world to believe in natural evolution. Darwin's followers were over-zealous in ten thousand times proving the correctness of his general theory. Mendel's followers show earlier signs of being satisfied with over-sufficient proof, and they are entering mightily into the effort to make his discoveries of large and immediate use to the world. With Mendel's methods of analysis and synthesis they are studying even the intricacies of human descent. They are showing that those unit characters which represent the worst of human dross may be discarded and that the better elements of human nature may be recombined in races of people averaging stronger physically, brighter intellectually, cleaner morally and withal more efficient as members of society. No one can as yet speculate as to the effect the science of genetics may have in helping humanity to evolve into races with superior heredity.

Heredity may be crudely likened to a fabric woven of many kinds of fibers and with many colors. Under this general conception of the nature of the "network of descent," suggested by Dr. O. F. Cook, the following observations may be made: That there are units in heredity or unit characters which may be likened to the units or individual strands of the woven fabric. That some of those units may be likened to different classes of fibers used in making the threads; others in the heredity of a species may be likened to the different fibers or threads of the fabric; others to the form of the fibers, and yet others to the strength of the fibers. That some unit characters may be likened to the entire fabric produced by the loom; some to the form patterns laid on the surface of the fabric by the loom; and some to the color patterns worked out by bringing to the surface of the fabric

threads of specific colors. Thus in living things there are woven into a systematic network general characters, as of form, color or habit; also characters of secondary importance, as of minutiæ of form, detail of color; and even characters so small as ordinarily not to be discernible. There are characters of prime importance in the makeup of plants and animals which broadly compare with the general appearance of the fabric, secondary characters which compare with the figures of form or color which may be woven into the fabric, and even characters relatively more minute than the almost microscopic fibers of which the threads of the cloth are made up. In reality, however, even the intricate organization of the product of the most complex modern loom but very crudely illustrates the delicate intricacies of heredity in the network of descent in living things.

The simile will also serve in another direction because there are agencies in the generative cell which determine how these unit characters shall be woven into the network of descent; as in the modern loom the perforations in the loom-ribbon determine which keys shall release the shuttles bearing the threads into their proper place in the fabric; or as in the street organ the perforations in the music-ribbon determine which keys shall strike the notes in making the harmony of the music.

The really stable part in the heredity of plant, animal or man is not the individual body—this runs its course and dies—but rather the germ plasm, which holds within its substance the well-nigh immortal threads of descent. These compete for place as they run through successive generations and are woven together in somewhat unique fashion in each individual. The discovery by Mendel and others that unit characters are inherited in pairs and appear in numerical proportions in the progeny was a great biological surprise. But the significant genetic facts are: that units of character are the stable parts of heredity; that, like the threads and colors of the cloth made in the loom, they may be so manipulated as to leave out of the combination those characters which are less desirable; and that the choicest characters may be recombined in individuals of higher excellence and higher average of efficiency. In some cases this elimination and recombination can be accomplished formally, while in other cases it can be accomplished only informally as by the aid of large numbers of hybrids.

In the light of the wide general experience of the breeders of plants and animals, efforts at mathematical recombination, while very important, represent only a small part of the intricate and truly large prob-

lem of gradually building up improved networks of descent to meet all the agricultural conditions in which plants and animals are used. As a matter of fact, breeders are coming to recognize the fact that this new philosophy of breeding will serve as a guide in the details of breeding work. The most of the work of animal and plant improvement will continue to be selection, including the discovery of the occasional mutation and the immediate or gradual segregation of this blood into a new variety or breed. Thus, even with this new science of heredity, breeding will still be mainly an art, and scientific methods will be used to supplement it. Thus, with many plants and animals, statistical records of performance may be widely used in determining the relative economic values of the different strains and families. In the breeding of many species there is relatively little opportunity for statistical methods, and a very wide range for the use of the judgment of the trained artist in discovering mutating qualities and in making desired combinations by crosssing and hybridizing. In some species the large results secured have come from mere art, and the use of very large numbers to find the occasional mutation and in the segregation and selective development of the mutating plant or animal.

Substantial advances are being made in cytology, which is the study of the internal anatomy and functions of the generative cell. Some of these questions are necessarily very abstruse and hard to investigate. Among them are these: How do the characters of the parents pass through the generative cell into the progeny? How does one character, as color in cattle, remain dormant in one or more generations, and then the progeny of a later generation reappear in apparently unmixed purity? It is clear that since the living organism carries the power of reproduction from one generation to another, carriers for the general, secondary, and minute character are multiplied every generation, so that each is represented in the generative cells of each individual among the progeny. Thus the new generative cell contains all the character determiners which control the complex makeup of the mature individual.

The new conception given by Mendel has helped to clear up the question of the influence which environment exerts on heredity in case of unit characters which have remained intact through thousands of generations of individuals and now powerfully maintain their unit purity in the presence of the opposing members with which their heredity carriers pair in the plasm or substance of the generative cell. The manner of origin of these unit characters, as horns in cat-

tle, color of eyes in man, stiffness of straw in wheat, and their heredity carriers seems to be the next great work for genetics students to attack. The breeding of animals has been left largely to private enterprise. While numerous new varieties of plants have been originated under public auspices, very little has been done in originating new breeds of animals at public expense. True, there has been some public assistance to associations in testing the cows of members so as to weed out the unprofitable ones, and in organizing associations for the ownership of superior sires, and some aid has been given to the dairy breed associations in their praiseworthy work with advanced registration based on records of actual performance. France and other countries have subsidized especially good sires so that they would be kept in certain districts, thus improving the live stock of those districts. Russia and other countries have done something at producing on government breeding farms, breeds or sub-breeds of horses for army mounts. The Department of Agriculture in coöperation with the Colorado Experiment Station has begun an experiment to produce heavy harness horses. It is also coöperating with the Vermont Experiment Station in improving the Morgan breed of horses. Together with the Minnesota Experiment Station it has assisted a coöperative association of breeders in establishing a circuit for the creation of a sub-breed of Shorthorn cattle known as milking Shorthorns. It has a similar relation with the North Dakota Experiment Station in aiding an association of breeders to establish a coöperative circuit breeding association in creating a sub-breed of Holstein-Friesian cattle.

The literature in reports, books, genetics magazines, and other publications already indicates that genetics is to be very fruitful in technique and in practical facts relating to the direction of the forces of heredity so as to make not only our plant and animal production larger but also to give us a cleaner and more efficient network of human descent. Our agricultural colleges and agricultural high schools, and other schools which give instruction to farmers, are beginning to take hold of this subject in its new form and to create new courses of study which are scientific, practical, and valuable from a cultural point of view as well as important from the standpoint of practical plant and animal improvement. Our educators and even our moral and religious teachers and leaders are beginning to study the newer phases of the subject of heredity in relation to their work. The first decade of the twentieth century will serve to mark the time when science laid hold of the subjects of heredity and breeding

in their larger constructive relationships in developing moral and general worth in men, and there is no phase of this subject which is now coming forward in a more significant way than the science of eugenics, or the improvement of the network of descent in the human family.

When the movement for world peace shall have centered all national power in one great federation, the patriotic instinct will become altruistic in a far broader way than now. The absence of strife with the outside enemy will leave the impulse of patriotism free to develop along lines of efficient service to the whole human family.

More than ever men will have patriotic pride in adding a new scientific fact, a new invention, a new piece of literature, a new variety of plant or animal, a new law or a new method of so organizing society as to make for the betterment of particular communities or of the whole race of men. The production of good citizens and the improvement of the heredity of the race, as well as the securing for all people superior environment, including education, will become a racial movement. Eugenics will become one of the practical sciences.

Patriotic people will not only desire to know the general values of races, families and individuals, but they will desire also specific knowledge of the presence, value and persistence of the unit characters of which their heredity is made up. It would seem that in no other function is our patriotism so unguided as in evolving lineages of human descent.

In our boasted patriotism in times of war, we have been blind to the fact that wars destroy a large percentage of our best men, giving a larger place in the continuance of the nation to the heredity of second-best men. Dr. Jordan's work in this Association has shown that this alone should be a most potent reason for the cessation of wars. Wars, instead of being necessary to keep up the virility of the race, weaken it.

It is not too optimistic to believe that under the direction of economic, political, social, and eugenic science we are to strengthen the blood currents of the nation, as well as greatly improve the environment of the individual. War as a means of world uplift has been overestimated. The value of science and altruism are never overestimated in making a better race of men.

That the scientific study of this subject is a patriotic racial duty can not longer be denied. To recombine and perpetuate those units of character which compose strong individuals, families and races and multiply them so that they may form a larger percentage of the whole

human family will come to be true personal patriotism. On the other hand, to produce people below the average in efficiency, and especially to combine unit characters which increase the defective and criminal individuals and families, will come to be considered definitely unpatriotic.

Patriotism, in its broadest and even in its religious sense, must be appealed to, that those families with the most efficient heredity may multiply rapidly and become a larger and larger percentage of the whole human family in each generation. In the absence of an awakening of this patriotic eugenic sense the efficient and well-to-do now, in too many cases, instead of having families large enough to rapidly increase their types, are having so few children that they become relatively smaller and llerams portions of the population with each generation. On the other hand, some weak, defective and criminal families are annually becoming larger and larger parts of the entire national heredity. And society, having protected them, through sanitation and charity, has helped this last-named class to become a relatively larger part of our population than when the law of the survival of the fittest had a freer scope to work out its harsh decrees.

It must be recognized that the great middle producing classes—our farmers, mechanics, and other manual workers—are our balance wheel in genetics as in economics and in politics, and our strength in times of war. Among them there is wide genetic variation as to individual family and racial efficiency. Eugenic patriotism to be effective must be generally operative among these substantial classes which produce the bulk of the efficient young to do the work of each generation, because from among this great class come most of our leaders.

The fact that science has started to organize eugenics is at present the striking new thing; and who knows what the future may develop? Whatever the result, it will not be visionary, and the movement, while conservative, may not be so slow as have many other movements for human betterment.

The aim of eugenics will not be different from that of education, physical, intellectual, and moral. It will be only another and more certain method of producing men and women of ideal character. The ideal remains the same, but the unvarying natural laws will be brought to bear in bringing about the desired result. Eugenics will help in producing a race which will more readily respond to general education and moral teaching; on which no money need be wasted in combating evil tendencies and weaknesses.

The deductive scientific method having found a foothold in relation to heredity in all living things, living protoplasm has more than ever come under the dominion of man's will. He proposes to weave new networks of descent in the form of plants which shall store up the energy of the sun more abundantly than any plants heretofore; other new networks of heredity which shall transform plant substance into more meat, milk, work and other forms of superior animal products; and yet other networks of human descent which shall make higher ultimate uses of the energy stored in plants and in animals and that supplied by mines of coal and oil and by waterfalls, waves, wind, and by direct sunshine.

The living fires of life are to burn brighter with less loss of precious genetic energy. Life itself is to be placed deeper and deeper in the crucible of scientific research. The pure metal is to be saved and the dross is to be discarded. A purified human heredity will aid in developing a better home life, in securing more effective education, and in leading to more effective religious teaching, in the production of superior races in all countries. Freedom from inborn weakness and from evil tendencies inherent in the heredity will be freedom indeed.

But the time will soon have passed when the burden of our efforts should seem to be directed toward showing the importance of the development of heredity and breeding. The time is ripe that we assume that all we have claimed is true, and that we should hereafter turn our attention to methods of work and to securing the means of support for definite projects, that the largest possible results may be secured. To nearly fifty committees of the American Breeders Association have been referred the problems of methods of breeding each class of plants and animals, and the study of heredity in man.

These committees are beginning to frame up plans for the wider coöperation of public departments and experiment stations with associations and individual breeders. They are giving encouragement and even direction to research both as to the laws of heredity and as to methods of creative breeding and the general variety and breed improvement by growers of pedigreed plants and animals.

The Association's Annual Report, wherein are preserved its more scientific papers, and the American Breeders Magazine, its new periodical devoted to the popular phases of genetics, are most efficient agencies for the preservation of the reports of the investigations of genetic science, and are beginning to have a wide influence among practical breeders. This Association has brought into coöperation the genetic scientists of America, and many across both the Atlantic

and the Pacific oceans. It has shown practical breeders that its efforts to bring the work of these scientists to them in its annual meetings and in its publications are successful and worthy of wide support and coöperation. It has organized the investigation of eugenics, so that genetic science is being applied in a most remarkable way to the study of heredity in man. It has not only proven the need but it has organized a basis for a genetics society of a hundred thousand members. "A hundred thousand members and a billion more of farm products annually" will make a good slogan.

The American Breeders Association has been signally honored by the National Corn Exposition in thus setting apart a day as its distinctive day. The management merits great commendation for having developed this exposition so distinctively along lines which blend the economic and the social, the vocational and the educational.

ESTABLISHING A BREED OF ALFALFA FOR THE IRRIGATED LANDS OF COLORADO

W. H. OLIN
Moscow, Idaho

We all realize that alfalfa is one of nature's choicest gifts to man. No plant of such economic value has been studied and grown so many centuries; no forage or grain plant today shows so little breeding as alfalfa. It has many and varying characteristics, and no distinct breed as yet has been firmly and satisfactorily established either in the Old World or the New, although this plant was an established forage plant in Persia before Greece and Rome had a place in history.

More than a decade ago the writer began testing the power of the alfalfa plant to reproduce its foliage and leaf characteristics in its offspring.

He started the alfalfa breeding work at the Iowa Experiment Station and later, at the Colorado Experiment Station, sought with his co-workers—Prof. Fritz Knorr of Fort Collins, Prof. P. K. Blinn of Rocky Ford, and Mr. E. B. House of Greeley, Colo.—to establish for that state a hardy vigorous type of alfalfa with a desirable quality of forage of sufficient yield to render it especially attractive to practical farmers.

Each coöperator used his own plan for obtaining the desired results. To supplement the strains already under investigation the writer secured through Mr. J. M. Westgate, of the U. S. Department

of Agriculture, seed from practically every alfalfa growing nation in the world. Mr. House seeded in rows 30 inches apart. Mr. Blinn seeded in hills 20 inches apart, each way, so the nursery could be cultivated with the beet tillage tools. The writer and Mr. Knorr, at Fort Collins station, seeded in hills 3 feet apart each way. We preferred this latter method because it facilitated isolation in the wire mesh gauze frames which we placed on certain units or plants which were the objects of special study.

Two years were given to the study of types and individual differences, which we found in the various centgeners of the alfalfa nursery. It was observed during the first winter that many plants in certain centgeners were winterkilled, the per cent varying from 2 and 3 to 80. The higher per cent in all three alfalfa nurseries was observed to be in centgeners planted with seed from the warm climate countries. The second winter there was a fine illustration of the "survival of the fittest," all the more tender types practically dying out. We now felt we could begin to determine from these more hardy surviving plants the proper "mother plants" from which to secure the desired breed.

Certain plants were selected for unit study, each having one or more desirable characteristics.

These plants were surrounded with breeding cages of wire mesh fine enough to keep out bees and other insects likely to transfer pollen.

Artificial pollination was practiced on these mother plants and others having desirable traits to transmit to offspring, so that few or no undesirable traits became established in the progeny.

A second series of tests was to determine the percentage of leaf to stem shown by selected plants. First the foliage was cut just as the blossoms began to appear and was weighed green. The foliage was air-cured in a closed room, then weighed again. The leaves were then carefully removed from the stems and weighed. The "green weight" varied from $14\frac{1}{2}$ ounces to 90 ounces per plant. The air-dried weight ranged from $5\frac{3}{8}$ ounces to 28 ounces. The per cent of leaf to stem varied from 23 to 58.

The third series of tests consisted of a study of stem growth and stooling power of the unit plants. At the Fort Collins nursery some 200 plants were deemed worthy of special study the second year. Our first test cut this down to 100, our second test to less than 20, and our third test to but 2 plants, Nos. 15 and 19. These plants seemed to combine the most desirable and the fewest undesirable traits of all the plants under study. For prepotent power, erect

stem growth, width of leaf, and per cent of leaf to stem (53 per cent), the writer chose No. 19 as the ideal mother plant. This was an offspring from Grimm alfalfa which came originally from the Minnesota Experiment Station. Prof. Blinn found his leading mother plant to be No. 7 in centgener F. This plant is a direct descendant of South Dakota No. 167, brought out by Prof. W. A. Wheeler at the Highmore, S. Dak., alfalfa nursery. It came originally from Northern-grown seed, and seems to be identical with the Grimm alfalfa. In the matter of stem growth both No. 7 at the Rocky Ford nursery and No. 19 at the Fort Collins nursery showed better stooling qualities than any other plant and in addition the stems were erect, vigorous, and bore a wealth of bloom and leaves. No. 19 had 10 per cent more stems than any other unit plant under study in the nursery. Where the normal leaf was $\frac{1}{8}$ inch to $\frac{3}{8}$ inch wide and $\frac{5}{8}$ inch to $1\frac{1}{8}$ inch long, No. 19 had leaves from $\frac{3}{8}$ inch to $\frac{5}{8}$ inch wide and 1 inch to $1\frac{3}{8}$ inch long, thus indicating the most *desirable foliage*.

The fourth series of tests was the root test. At the Fort Collins Nursery our work was interrupted by college changes, both Professor Knorr and myself going into other work, and our selected and choice No. 19 as well as our other selections were destroyed, the alfalfa nursery giving way to an oat crop. At Rocky Ford Mr. Blinn continued the breeding work, as did also Mr. House at Greeley.

While Professor Knorr and myself found there was a difference in root maintenance, and some difference in constructive root growth, it remained for Prof. Blinn to find out just what caused that difference in the vitality of various alfalfa plants. This he did in the season of 1910. To satisfy himself that he had really discovered an essential principle and that it was not a local trait, Prof. Blinn visited many alfalfa nurseries throughout the country during the growing season of 1910. He found in each nursery this same trait in the more promising plants. Then he knew he had discovered a most valuable and vital principle in the root growth of alfalfa. It enables him to divide all alfalfa plants into two classes as far as root growth is concerned. All plants, seed for which came from warm climates, have a pronounced tap root, with but few if any side or lateral roots; all plants from Northern or cooler climates have a dominant tap root but carry pronounced and important side or lateral roots.

For this reason if any accident occurs to this tap root, cutting or rotting it off, there remains enough strength in the lateral roots to enable the plant to reëstablish itself. In case of the Southern type the plant dies. Hence we see why this Northern type is so much more vigorous and hardy.

Progeny from No. 19 have been preserved, and this season of 1911 Professor Blinn will determine which shall be the unit mother of the particular breed which he shall propagate for Colorado conditions. The essential traits he seeks to have inherent in this Colorado breed of alfalfa are as follows:

(1) Hardiness or resistance to winterkilling.
(2) Resistance to leaf spot or other foliage diseases.
(3) High percentage of leaf to stem.
(4) Medium-sized leaves and medium-sized stems.
(5) Good seed-producing power.

A definite pedigree will be worked out and an attempt made to keep the strain pure.

From several thousand plants we thus see two plants stand out. These two are almost invaluable because of the inherent possibilities which lie within them.

Each of these plants may produce a progeny that will increase the yield at least 1 ton per acre under field conditions, to say nothing of the improved quality of the hay. This will mean millions of dollars to *Colorado alone each year*, and what must this improvement mean to the nation?

Members of the A. B. A. are urged to encourage Professor Blinn in his efforts to evolve this desirable and much needed breed of alfalfa.

TWINS, HEREDITY, EUGENICS

JOHN H. CHASE
Cambridge, Mass.

There are two kinds of twins; those so much alike that it is hard to tell them apart, especially in youth—called duplicate or identical twins; and those who seem to be no more alike than ordinary brothers and sisters. Some biologists have claimed that identical twins spring from the same germ cell, which becomes accidentally divided, and therefore all qualities which depend on heredity will be the same for these twins. But since environment is almost identical for twins it is hard to separate the qualities produced by their environment from those produced by their heredity. It occurred to us, however, that environment was just as strong for two ordinary twins as for two duplicate twins, and therefore qualities produced by environment should make ordinary twins alike. If duplicate twins are more alike than this, then the "more" is produced by heredity. Perhaps

this residuum—this "more"—if it could be segregated, would solve the problem.

Thinking that this was at least worth investigating, we wrote to the secretaries of about forty American colleges, asking if they would be willing to send the names and addresses of any twins now in college, or any whom they remembered as having graduated. We felt that college men and women would be more interested in the problem, better able to analyze themselves, and more likely to return a questionaire than any other group. We obtained in all the names of about one hundred and fifty pairs of twins, fifty of whom answered. About thirty were "identical," and twenty "ordinary" twins. The questionaire sent to them was as follows:

QUESTIONS ON HEREDITY

No one knows what qualities are inherited, and what are acquired after birth. If we could know exactly, it would be a great advance for science and a great help in education.

It has been discovered that duplicate or similar twins probably occur because the original germ cell is accidentally divided; therefore, duplicate twins arise from the *same* cell. As a result, their inheritance should be the same, and the qualities in which they differ must have arisen after birth. If, then, the twins of the United States are willing to answer certain questions, they may be able to solve one of the greatest problems of science, namely, What part of our nature is due to heredity and what part is due to training?

Would you, therefore, be willing to answer the following questions which will be confidential?

I. PHYSICAL.—(a) Are you and your twin "duplicate twins," namely, during youth, did you look very much alike?

(b) How much do you and your twin differ in height?

(c) Strength: Could you always lift equal weights, or has one always been stronger than the other?

(d) Health: Has one always been more sickly than the other? Have you had the same illnesses?

(e) Look at the palm of your hand; halfway between the end of your finger and the first knuckle, the tiny ridges in your skin twist round into a pattern. Have you and your twin the same pattern for corresponding fingers?

II. MENTAL.—For which *one* of the following subjects have you a special aptitude? (If you both like the same thing, put two crosses in front of it; if your preferences differ, mark the subjects separately.) Only mark one subject—your chief preference and the chief preference of your twin.

(a) Mechanical interest.
(b) Natural science. (Especially fond of nature and animals.)
(c) Business ability.
(d) Musical ability.
(e) Artistic ability or appreciation in any way.
(f) Literary.

III. EMOTIONAL.—(a) Are you equally social? (About the same number of friends.)

(b) Are you equally fond of the opposite sex?

(c) Have you the same interest (or lack of interest) in religious things?

(d) Have you similar dispositions or temperaments?

Do you know of any other twins to whom we could write?

REMARKS.—As far as we know, this is the first investigation of this kind, so if you think of any other likenesses or differences, or distinctive qualities of interest, or have any suggestions, please write them on the other side of this sheet.

NAME:

ADDRESS:

The answers were as follows:

Feature.	Duplicate twins.		Ordinary twins.	
	Alike.	Unlike.	Alike.	Unlike.
Height[a]	20	6	3	12
Strength	22	3	5	7
Health	23	2	5	7
Fingerprints	16	1	2	5
Mental	16	6	2	10
Social	21	1	9	4
Sex attraction	26	1	11	2
Religious	26	2	8	5
Temperament	18	7	4	10

[a] A leeway of half an inch was allowed for crude measurements, high heels, or wavy hair. In the case of strength, health, finger prints, etc., no leeways were allowed.

What results can we glean from these figures? First, that the theory of "identical twins" in the literal sense of the word "identical" is probably disproven. Although duplicate twins are alike, they are not exactly alike, as they should be on the theory of accidental division of the germ cell. Especially sad for this theory is the fact that fundamental qualities such as eye color may vary while all other physical and mental features are duplicated. There seems to be no general law for this variation; the three duplicate twins out of the twenty-four who vary in strength do not include the two who vary in health, although health and strength would seem closely related. Out of the nine features studied there is not a single characteristic which is alike between each pair of duplicate twins. Prof. Edward L. Thorndike gives more elaborate proofs of the same point in his "Measurements of Twins."

But if the theory of identity vanishes, there is another law which seems to emerge and which is the all-important conclusion of our work.

It is this, that, no matter what the physiology, embryology, or metaphysics of twin formation may be, statistics show that duplicate twins are, on the average, three times more apt to be alike than ordinary twins. Now the importance of that law lies in the fact that if duplicate twins are bound by a triple cord of heredity then they give a standard by which we may determine whether any given trait is hereditary or produced by environment; for we can ask a large group of adult twins concerning any given trait. If their answers respond to the 3/4 law the trait in question can be regarded as an hereditary quality, while if not it must be regarded as being produced by environment.

For instance, let us apply the law to the study above. Finger prints, height, strength, health, mental tastes, and temperament are 2.4 to 3.8 times stronger in duplicate than in ordinary twins, which with so few returns is as near the law of three as could be expected. But religious taste, sex attraction, and sociableness are only 1.35 stronger in duplicate than in ordinary twins. Therefore, as far as our returns go, we are warranted in saying heredity has little to do with our religious, or sexual, or social natures; but it is the all-important element in our health, our strength, our temperament, and our mental tastes. Now I do not claim that these results concerning definite things such as religious taste are completely substantiated, for our returns are too few to form final judgments on so important a subject; but I do claim that the above *method* (the law of three) is correct statistically and scientifically for solving and not for theorizing about the great problem of heredity versus environment. It is a method for determining way down into detail the smallest parts of our nature that are inherited. Our study above might not have proven this law, but Dr. Thorndike carried out definite measurements—such as circumference of head, width of head, length of finger joints and forearm, eye color, hair color, word tests, etc.—among 50 New York City school children who were twins, and he found the same law applied among these definite *measurable* factors.

Unlike us, he found difficulty in distinguishing between duplicate and ordinary twins. But Francis Galton found no difficulty on this score, and not a single one of our questionaires was returned with uncertainty on this point, while popular opinion, which is often a good judge on social questions, almost universally recognizes the fact of there being these two types of duplicates and unlike twin.

If, then, the law of three be substantiated, it can be applied to problems, such as the following:

Is cancer transmitted? For instance, if, by an exhaustive questionaire, duplicates were found to be three times as liable as ordinary twins to cancer, then this disease could be considered hereditary. The same method could be used in determining whether consumption was inherited or was simply a tendency. Are certain crimes voluntary or preordained from the time a child is born, and therefore should a given criminal be taken to court or to a hospital?

What are the great hereditary departments of mind and taste that the directors of our vocational bureaus, employers, teachers, and children themselves should know in choosing an occupation? A close study of our returns would seem to show that "art" and "music" should not be separated, while "literary taste" upholds its separate existence as an heredity department, although at first we did not even mention it in the questionaire.

Again, it could be determined through a more exhaustive investigation whether our results concerning health and strength are correct —namely, whether they are dependent almost entirely upon heredity, and very little upon a gymnasium or environment. Francis Galton in his study of twins even concludes that diseases are preordained not only as to their occurrence, but also as to the time at which they will be contracted, because so many of his twins had the same diseases at the same time when in different parts of the country. Our results are not detailed enough to bear on this question, but they do show that health and strength are very dependent upon heredity.

Professor Saleeby says that the reason Greece and Rome and every ancient civilization came to fruition and then declined is that barbarism by its stern life kills the weak; but as civilization advances a chance is given the weaklings to find some little niche in society where they can do a small work and live, and where comforts will sustain their feeble existence and allow them to have children, until finally these weaklings accumulate to such an extent that they are not able to support the civilization that their strong virile ancestors have built up, and the whole structure of society topples over. We could preserve the cumulative good effects of civilization and our own robust lives if we would consciously bring about the breeding of the strong and capable; instead of making it necessary for the weak to be eliminated by natural selective processes; or make it necessary for civilization to return periodically to barbarism in order to be purged.

If it is proven that a predisposition to illness and lack of stamina is inherited, then weak people who know that they will hand on their misery to their children should refrain from marriage, just as at pres-

ent many with a family tendency to insanity are refraining from marriage.

Again if our conclusions be correct, bad tenement houses, child labor, lack of playgrounds, etc., may determine ill health and weakness in a measure, but a weak, degenerate father or mother would be a much larger factor in the result; and if this be true, an over emphasis has been given to these environmental influences as compared to the far more important subjective of hereditary influence. If as much time were spent in forming public opinion and legislation against allowing those of feeble mind, those of feeble body and those with an abnormal hereditary taint to have children, and in encouraging—even by means of a public or private pension if need be—large families among the especially able, public spirited, and strong, then our civilization would be saved, and then our sturdy descendants would be amply able to attend to the matter of forming a pleasant and healthful environment for themselves. For we can probably breed capacity and goodness as well as strength.

In the past it has been objected that there was no way to determine exactly, so as to compel popular assent just what qualities were inherited and to what extent. But twins have now been found to be the magicians who can unravel the skein of this mystery that has puzzled our fathers for generations, and whose solution may now be the means of arousing such a new, practical, workable interest in the new science of eugenics that our present civilization may be saved instead of having to swing like a pendulum back into barbarism. This can be done by having the attention of our philanthropists, women's clubs, reformers, insurgents, the Outlooks, the Surveys, the 15-cent magazines, our Ben Lindsay's, and Roosevelts turned from an almost exclusive study of how to better the world through improving environment to the more important subject of how to better the world by improving the race through the laws of heredity, and by spreading the knowledge of those laws broadcast through society so that the people of America and all other civilized countries will gradually change present customs and practices in conformity with the new knowledge, to the end that the nations may go forward toward a greater physical and mental perfection. If they fail to comprehend this thoroughly, to reform their lines of advance, it is inevitable that within a few hundred years they will have to fall back into fighting barbarism.

Eugenics, with the study of twins as a basis, can be a strong factor in this general advance.

INHERITANCE OF "ACQUIRED EPILEPSY"[a]

DR. L. B. ALFORD
Monson State Hospital, Mass.

Brown-Sequard (1860) stated in one of his series of articles on Brown-Sequard "Epilepsy" that he had in a few instances found the condition in the offspring of "epileptic" animals when there had been no operative interference. Westphal (1870) confirmed Brown-Sequard's results, but a number of other observers, including Dr. Taft of the Monson State Hospital (1910), were unable to confirm them.

This work, primarily a study of the nervous mechanism of the phenomenon, has demonstrated that it is the poorly coördinated, simultaneous action of a number of defensive reflexes. These reflexes have become unusually active as a result of frequent repetition. The incoördination following the experimental lesion has rendered the movements ineffective in removing the exciting stimulus, and the constant presence of these stimuli causes many unsuccessful attempts to remove them. By actual count, the number of scratching movements has been found to be greatly increased. The exciting stimuli have been found to be the vermin that infest the bodies of practically all guinea pigs, and when these are removed the "epilepsy" fails to develop or disappears if it is already present. Any lesion that disturbs the most important defensive reflex, the scratch reflex of the hind leg, will be followed by the "epilepsy." Besides cord lesions, and section of the sciatic nerve in the hip, the lesions which Brown-Sequard found sufficient—removal of the toes or even removal of only the distal phalanges—are followed by the condition. This accounts for the presence of "epilepsy" in some of the offspring of Brown-Sequard animals, he having found that in all cases the inherited "epilepsy" was associated with a loss of the toes on the hind feet of the animals.

Anything that affects the reflex condition of the cord has a similar influence on the epilepsy. After spinal irritants such as caffeine and strychnine it can be obtained with greater ease, but following an injection of a small amount of alcohol it quickly disappears. It was found to occur in a more severe form after removal of the higher centers, and can be obtained with great ease after destruction of the cerebellum and section through the lower part of the pons. It may even occur in normal animals after such an operation. It still re-

[a] Read before a meeting of the research committee of the Section of Eugenics, at Palmer, Mass., May 1, 1911.

mains after a double cervical cord lesion, a semisection on one side in the upper cervical and on the other side in the lower cervical regions. After cord lesions movements may occur in an attack in limbs paralyzed for voluntary motion.

Thus not only has the presence of the condition in the offspring of Brown-Sequard's epileptic animals been accounted for, but also the condition itself has been shown to be of such a nature that inheritance would not be expected.

METHODS FOR THE IMPROVEMENT OF SORGHUM

A. H. LEIDIGH
Kansas State Agricultural College, Manhattan, Kansas

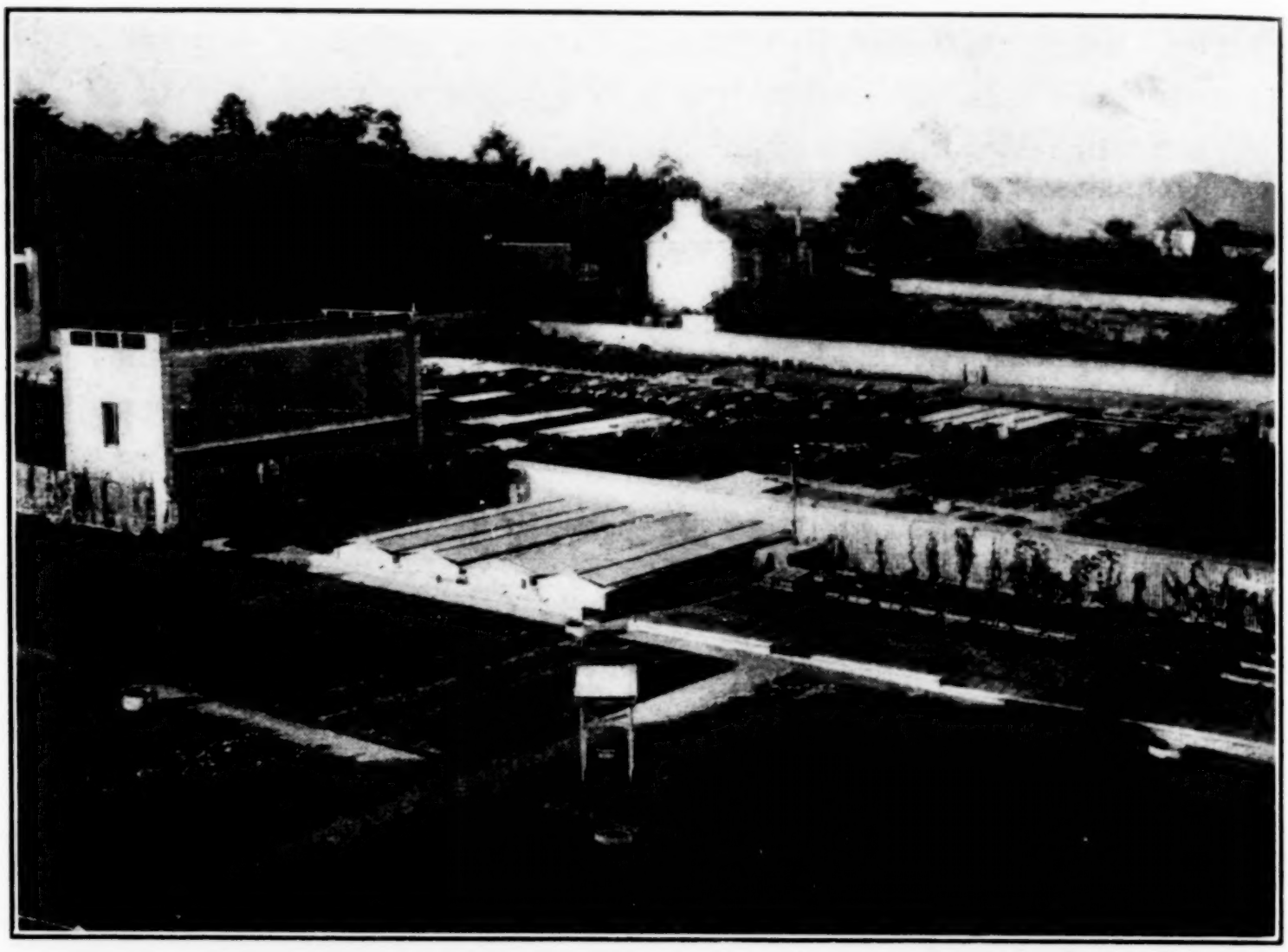
For some fifty years the various sorghums have commanded an increasing amount of attention in the United States. During that time the actual progress in producing sorghum varieties has been made mostly by determining which were adapted to certain localities. With the settling of the non-maize producing districts a greatly increased importance is being given to many types and varieties of the sorghums.

For the past eight years the writer has been associated in various places with projects which have involved the improvement of the adapted sorghums. The results thus far show that very little improvement has ever been accomplished in America. Of the early efforts to increase the sugar contents of the sorghums we can say that no known result remains except from a variety testing standpoint. C. P. Hartley has produced a broom corn cross with sweet sorghum. A. B. Conner, C. R. Ball and the writer have tested varieties and aided in distributing some of them. Dr. C. O. Townsend has done some very definite work on the syrup and sugar sorghums. A. M. Ten Eyck has probably had a better opportunity than anyone else to take up already adapted varieties and increase their usefulness. Each of these men have worked more or less disconnectedly along independent lines. There has been no coördination of ideas and no well defined technique has been developed.

In outlining a project for the improvement of the sorghums at the Kansas Agricultural College the writer has decided to test the production of sorghum from bagged heads. The purpose is to compel self-fertilization. Assuming that these plants are naturally self-fertilized it seems fair to suppose that most of the variations within

a given variety are due to crossing between different plants. If we can eliminate this without reducing the vigor or productivity of the crop we will have made a great step in advance. The work accomplished by Shamel and others on tobacco is probably an illustration of what may be done with sorghums. The writer has assembled data from the men mentioned above. They agree that this group of plants are self-fertilized. Conner, Ball, Ten Eyck, Townsend and the writer have all produced viable seed from flowers protected by bags. Conner, Ten Eyck and Townsend have produced two or more generations of plants from bagged heads. They were forced to resort to bagging because of the proximity of other varieties. That is the work was done simply from necessity. C. R. Ball bagged heads to guard against insects. The writer bagged heads to eliminate danger from head smut at flowering time. Because the work of bagging has been done incidentally very little importance has been attached to it as a practical method for constant use. However, Ten Eyck used it at least four years and some of the strains are now very largely grown over the state with excellent results. Connor states that a particular strain of Orange sorghum which he grew two generations from seed, bagged each year, possessed extraordinary vitality and vigor and was remarkably pure and uniform. Townsend says he has had similar results.

The writer presents these observations here in the hope that this will stimulate experimenters and farmers to test this method. Several men who have had a great deal to do with this crop during the past few years say they are about ready to abandon the head-to-row method of testing varieties or individuals. This they unanimously state is because of cross pollination. They hold that cross pollination practically destroys the identity of the individual strains in a short time. To these men especially I suggest the bagging method. It should make it possible to eliminate the remnant system. It ought to accomplish its purpose whether one variety or hundreds are being grown. The Kansas State Experiment Station has this year started work near the extreme northwestern corner of the state, to produce seed of the sorghums which are adapted to that locality. Kafir and Milo in particular are subject to variations and splitting up when grown there from seed grown in lower or more southern parts of the state. It is hoped that a few years of selection accompanied by bagging the heads before flowering time will give us not only desirable but also uniform types. Seed so grown may probably be used generally throughout that part of the state with much greater success than is now possible with seed not locally grown.



VIEW OF THE FLOWER BREEDING PLOTS ON THE PLANT BREEDING FARM OF ANDRIEUX, VILMORIN AND CO., VERRIERES, FRANCE

BIOLOGICAL (GENETIC) LIBRARY, FARM OF ANDRIEUX, VILMORIN AND CO., VERRIERES, FRANCE

EDITORIALS

THE BREEDING OF MAN

Between methods which may be employed in the improvement of the heredity of the human species and the improvement or modification of other living things there are some decided and fundamental differences. In forms of life lower than man, useful variations can be arbitrarily segregated and multiplied. Thus, a new variety of apple or wheat originating from a single mother plant may supplant all the parent variety in a certain section of a country or even an entire country. Or a new variety of corn, or a new strain or breed of cattle or horses, originating from a group of superior parents, may take the place of the parent variety or breed. No such simple processes, however, are available in the human family. In the present state of information and sentiment we have no means which will encourage the best families to multiply somewhat more rapidly, but the State may place restrictions around marriage of the insane, imbecile, defective, diseased and other racial undesirables and thus by elimination have no less direct influence in bringing up the average heredity of the race. Society may even soon see the wisdom of tabulating the breeding values of all families, thus to emphasize to the strong their racial value, and to the weak their genetic weaknesses and the fatalities which are almost certainly in store for their offspring.

As a matter of fact, society, through charity, helps to keep alive a very large percentage of the weak children of the least successful families; in war we destroy the strongest, most virile of our men; both factors are active in depressing the average value of the racial blood.

Choosing the capable few as the progenitors of a new race, as can be done with plants or animals, and rapidly making their blood that of the race, is impracticable with the human race. On the other hand, something can be done, even if that be quantitatively only a small percentage of what can be accomplished with wheat, cotton, apples, or cattle. For instance, we can arrange to so record the lineage and genetic values of all families that the racial value of each strain of blood may be known; we can privately provide bounties for children born to parents with a superior rating, the bounty to be progressively large as the number in the family increases; we can educate men to avoid venereal diseases, alcohol, and other agencies which decrease their value as parents; and we can be somewhat more exacting in licensing only the fit to marry—and to kill fewer strong men in war.

The throwing together of different racial types develops not only economic and political problems, but eventually hybrid race problems of the most far-reaching character. The hereditary values of the pure races as compared with the hybrid race should be studied from every standpoint.

Records of the performance values of all individuals would soon give data upon which to base the breeding values of each parent; and of estimating the breeding value of each person from whom progeny are not yet available for records on which to base parental values. Thus those families whose genetic values coincide with the average of the racial values would be known; also those families averaging above as well as below the normal for the race. In this manner the particulars in which the best families excel, as well as the lines of weakness of the weaker families, would be available knowledge.

No one can more than conjecture as to whether statistics of good qualities and of faults in the heredity of young people would cause fewer marriages or more marriages on the whole. In reply to those who would argue that the possession of such information would lessen the number of marriages, increase the social evil, and even decrease the production of children, it may be said: The larger proportions of really happy marriages sensibly contracted would make marriage popular. The assurance arising from a better knowledge of both contracting parties as to the success of the issue would lead people to look upon marriage as more certain of a happy ending. Threatened penalties of being ruled out of matrimony on account of unfitness would be a tremendous inducement to lead many persons to courses of rectitude, and to care in preparation for parenthood.

Society and the church would increase their approval of good marriages the issue of which is likely to turn out well. People would in this, as in other affairs of life, do nearly as they are expected to do. The possession of facts would give assurance that an intelligent interest would be taken; and this interest would work out for good. The truth prevails in the light of day.

Well conditioned marriages of people of strong power to succeed in life's affairs and with faith in their eugenic ability to rear strong and healthy children would bring the blessing of at least average sized families. A community made up entirely of successful people would in time have a large surplus of means with which to take the risk of doing well by large families of children. The removal of the fear that children will be defective, weak, sickly, unsuccessful, or will go wrong, will give people both the courage to rear children and the family pride to have a goodly number of children and grandchildren.

SOMETHING MORE THAN THE COMMERCIAL INSTINCT NEEDED

Seldom, if ever, has a man achieved marked success as a breeder of improved live stock who has not perpetually cherished a real fondness for live stock extending far beyond that mere financial interest which dictates to a considerable degree the operations of the majority of men who would be called live stock breeders. Often there lies beneath a rugged exterior of a man, a genius not unlike that of the artist to whose eye every feature and every line in conformation of an animal contributes either to its beauty or ugliness. The imagination of the great artist goes beyond that of the plebeian critic. It takes an artist to appreciate the work of an artist. Just so the achievements of the master breeder are best appreciated by other distinguished breeders.

The meat or milk producer sees nothing in the animal but its ability to produce beef or milk. The breeder demands certain other points of excellence, which for want of a better term may be called embellishments. The breeder has a right to satisfy his tastes in the matter as long as these tastes do not detract from the usefulness of the animal or add materially to its cost. The breeding of pedigreed live stock, without permitting sentiment, embellishment, and "fancy points" to enter into it, is like insisting that four walls and a roof constitute home, or that the farmer should not locate and construct the house and other buildings with reference to making them sightly and attractive. Fancy points should not be encouraged to the exclusion of utility. Utility in improved live stock is fundamental.

Breeders of pedigreed live stock in the United States are no longer scarce but live stock breeders of significant achievement are rare. Many farmers have been inveigled into the breeding of improved live stock by the promise of attractive profits. Reported fabulous prices for individual animals have been the magnet that has led many farmers to abandon the more conservative practices and engage in breeding pedigreed live stock. Only those who have had extended experience in the breeding and sale of improved live stock can fully realize the full cost of the outstanding animal that brings the unusual price, to say nothing of the countless cases where fabulous prices have been reported, which have never been realized except as credited to the breeders' advertising account.—HERBERT W. MUMFORD, *Urbana, Ill.*

GENETIC SURFACE INDICATIONS

Beginning about a third of a century ago, there developed a school of animal breeders with a philosophy which has had an enormous

influence. Its leaders, vigorously but in part thoughtlessly dealing with the genetic economics of our live stock industry, occupied some position as writers most advantageously in touch with the live stock world. Some of these leaders were chosen as judges at fairs and even teachers of animal judging. Their work covered all classes of live stock, including poultry and pet stock.

That school of breeders imagined that in a brilliant and artistic literature of word painting it had a philosophy. The influence of this philosophy has helped to breed out the milking qualities from the heredity of American Shorthorn cattle; held back the dairy development of the Red Poll cattle; kept back improvements in breeding for excellence in egg laying in poultry; delayed the development of tense fiber, endurance, easy keeping, and longevity in our draft horses; and made possible that greatest of all American live stock fiascoes, the Belgian hare craze.

This philosophy enthroned form and fat above genetic power as the criterion of individual excellence in the show or sales ring. Outward signs of excellence usurped a place above inherent breeding power. Centgener tests such as are now used in dairy cattle and speed horse breeding were long laughed out of court by those who spread their philosophy over millions of pages of reportorial and editorial rhetoric concerning beefy draft horses, steers which exhibited the greatest profusion of beautiful lines and curves, porkers whose exteriors of fat padded skins most nearly met the artistic ideal in the mind of the man who happened to be judge that year, and mutton animals with the pre-sheared fleeces. Even the results of such transition tests as milking tests of cows at fairs and egg-laying tests of hens were treated as matters of small import and received but scanty mention. There was a grandiloquent magnification of form which blended with the excitement of the sales and show ring—a manifestation of the excitable character of many of our people.

It would not be true to assert that emphasizing the outward appearance of the individual has not had a very high educational value; or that it has not given the American people vastly higher ideals of excellence to be striven for in animal breeding. It has helped to make possible our live stock fairs and our live stock auction sales; and has been a strong factor in leading many to enter the breeding of pedigreed stock in a large way. It has enormously encouraged the beginner at upgrading his stock, also the beginner at breeding pedigreed stock, to make his start to pay commensurate prices for a pedigreed sire or for a purebred foundation herd. Nor would it be fair to say

that there has been no progress in the breeding of our meat stock and work stock. But it has gone on, not so much because of, as in part in spite of the partial philosophy of those who with voice, pen, brush, and camera have exalted the individual outward appearance above internal genetic power. Some of the progress which has been backward has been largely due to this ingrowing philosophy which has been wedded to a system which yielded "copy," and yielded advertising with accompanying editorial write-ups. The facts and figures developed under the performance record tests, as for instance in advanced registration of dairy breeds, do not require wordy descriptions nor highly colored full-page advertisements to sell the breeding animal whose progeny or close relatives give a high average of production. The trotting horse with very many progeny or other close relatives showing a high record of efficiency in performance on the race track does not need much rhetoric to convince the prospective purchaser of the breeding value of its blood.

The injury done has been in assuming that we already have great excellence in our breeds of meat stock and work stock, because perchance we have an occasional phenomenal individual. When we compare animals of the beef breeds with animals in the advanced registries of the dairy breeds, we see that our meat-producing breeds of live stock have not been subjected to rigid tests for real genetic as well as individual merit, nor have they been improving at so rapid a rate.

The breeders of beef, pork, mutton, poultry, and work stock have already too long assumed that tests of performance, so successfully worked out with dairy cattle, and centgener tests of wheat and corn and other plants, could not be applied to other breeds. These unwarranted assumptions have too long led breeders to depend on the continued importation of choice animals of the breeds created in the British Isles and western Europe, without an effort to do as was done in the old countries and create new breeds and sub-breeds.

But a new movement is in progress, thanks mainly to Mendel and his disciples, and to a school of optimistic plant breeders who for a decade have been devising methods and getting results in creating new varieties of useful plants. Plants which seemingly presented vastly more difficult problems than Hereford cattle, Berkshire swine, Rambouillet sheep, or Shire horses have been brought under performance-record breeding, and newly created varieties are being turned out. The most advanced breeding today, it is safe to say, is done with corn. And the most important and the most difficult features in corn

breeding are applicable to the work of creating new values in the breeds of live stock. In fact, some of these features are being employed by some of the few animal breeders who do really creative breeding.

The writers and teachers of the old school to which reference is here made have been guilty of sins of omission to a marked degree. They have failed to see the most important elements in the philosophy which guided Cruikshank in creating a family which has put short legs and easy feeding quality on Shorthorn cattle, or to see what guided Gentry in producing his record-breaking herd of Berkshires. The word artist who, seeing only the outer appearance of the steer, the sheep, the pig, the draft horse, the nicely pencilled fowl, or the symmetrical ear of corn, has been so blind that he has made the too sweeping generalization that inbreeding is wholly wrong, but which Bates, Cruikshank, the Funks and others have so abundantly disproved. Inbreeding is dangerous when weaknesses are present, but it is a most powerful agency in keeping pure the very best stocks, whether of plants or of animals. By repeated trial Gentry found that his inbred crops of pigs were far better than those resulting from outcrosses, and he was sensible enough to obey the law of nature as practically worked out in the pigs rather than follow a theory which does not apply to all families even of hogs.

Not only has the aforesaid philosophy of the supremacy of form and appearance been in the way of a scientific knowledge on the part of the common breeder of purebred stock, who usually is a multiplier of genetic values secured from others, rather than a creator of new genetic values, but it has been especially harmful in retarding men and associations from undertaking real, constructive, creative breeding.

But the light is breaking. The old school is beginning to see the philosophy of the occasional mutation in the blood of which, if guarded by narrow breeding, there is held the basis for breed improvement. And young men less hopelessly grounded in the principles of the old-time stock sales oration, or stock show editorial, are entering the live stock editorial field. There are even strong rays of hope in poultry editorial circles. The camera is now telling the unexaggerated truth, where formerly the pencil and brush supplied excellence to all flesh indiscriminately.

Animal breeders, in the half century after Darwin put forth his world-changing philosophy in 1859, were practically static. A score of years of scientific and brilliant breeding on the part of plant

breeders about the first of the new century was necessary to awaken them to the vast constructive opportunities in animal breeding. The possibilities from Mendelian recombinations in cross-breeding; the necessity of using vast numbers in creative breeding; the need of collective effort, as in the circuit scheme of animal breeding; the utility of system and order carried out on a large and uniform scale in the effort to create breeds with capacity to yield products at lower cost, and the opportunity for the application of scientific efforts on a large scale, are only the entering wedge. There are many things which portend the rising tide of scientific development in animal and plant breeding, and the mission of the *American Breeders Association* is to lead the van. The totality of heredity of animals in the world, part of which have not yet been imported, and part perhaps as yet untamed, is a mighty force which we can mould better to meet our needs.

Our rich home market for pedigreed live stock, supplemented by the possible foreign market for purebred animals, will make not only possible but relatively easy a great movement in the creation of breeds and families of all kinds of domestic animals whose genetic records will gain for the successful breeders both fame and wealth. The breeders of dairy cattle have only begun to show what can be done all along the line in this and other countries with all classes of farm animals, including fur animals and pet animals as well.

The live stock journals will continue to exploit and conserve the interests vested in the existing commercial herds. And it is well that they should perform that important function. But henceforth there will grow up more facts concerning the inner genetic values of breeds and especially of families within the breeds and the writers, auctioneers, and teachers will thus have figures and genetic pedigrees, which will enable them to conserve and exploit those animals which breed best, rather than merely the prettiest individuals. In fact a change for the better has already taken place in case of species where performance records have longest been recorded.

THE LAW OF VAST NUMBERS

Practical experience in the improvement of living things through breeding demonstrates that the law of vast numbers must be respected. One phase of this law is that one among many is superior as an individual to its fellows. A second phase of this law is that among many of those superior individuals there is one superior also genetically, excelling in its power to transmit its superiority to its offspring.

In other words, among the thousands or even tens or hundreds of thousands which make up a variety, a breed, or a species there are only a few mutating individuals which transmit marked superiority. A third phase of this law of vast numbers is that to effect general improvement in a variety or breed the progeny of the individuals which prove genetically the best must be multiplied into vast numbers, that they may supplant the individuals which have lower genetic value.

These statements of fact would at first seem hardly worth the dignity of being called laws. But these three facts should be burned into the minds not only of those who try to create new values in plants and animals but also of all genetists, whatever their scientific or practical interests in breeding and heredity.

In part because of disregard of the law of vast numbers and the following of plans numerically narrow, most of the efforts at creative breeding fail to produce stocks which are really valuable or new or represent material advance. On the other hand the relatively large numbers of the really important mutating blood lines which spring up through the everyday work of growers and modest breeders are due primarily to the vast numbers constantly passing under review in everyday production, and as growers become better trained, not only to see mutations but also to seize upon them and subject them to clonal and seminal centgener tests, their discoveries will increase.

Our farms and nurseries for plant breeding as well as our establishments for multiplying superior varieties and breeds of domestic plants and animals should be laid out so that the scientific methods of intermating and selection may be carried out on a large scale. There is here need of largeness of plan and equipment, and the work of the producers, especially the producers of pedigreed plants and animals, should be so systematized that mutations, wherever they arise, may have a chance to gain the eye of someone who will appreciate them and give their blood a genetic opportunity.

Preliminary and preparatory to all nursery work and other technical work in plant breeding, the law of vast numbers should be respected by so testing many varieties as to secure those which may be the best bases for the work of breeding. Large numbers must be used in the nursery in the work of hybridizing and selecting. And to follow the work out to the end of practical trial by growers, a rather large number of the newly formed varieties should be taken from the preliminary trials of the plant-breeding nursery through the field plat trials at numerous trial grounds, as at branch experiment stations.

There is, however, one place where it does not seem wise to adhere to the plan of large numbers, namely, where it comes to distributing new varieties of plants to growers. A few rigidly tested very best varieties will do more good than a larger number of best and second-best varieties thus distributed. A commercial variety enters a complicated set of farm conditions and often a still more complicated set of market conditions. Especially is this true of a product like cotton or wheat; here the method and machinery for the manufacture of the new variety must be readjusted, and in some cases even radically changed. The market must learn of the character and quality of the new potato, apple, or melon, and in some cases the grower must adjust his farm conditions to give the new variety the proper culture or treatment. Thus, in making new tall-growing varieties of flax, it was found that a new scheme of crop rotation was necessary to prepare the land and clean the soil of weed seeds, to avoid the necessity of separating weed fibers from the flax fiber.

In animal breeding the individuals to be used as bases for breed improvement or for the creation of new breeds must be chosen with care from among the very many animals of the foundation breed or component breed which have the largest practical value, first individually and then genetically. The individuals of families which appear best are collected and their genetic value determined in the terms of their progeny; these again are tested and retested generation after generation, so as to eliminate the poor characters and recombine the best characters in a comparatively narrow line of descent worthy of advanced registration on a performance record basis. There must even be provision for bringing into the newly forming sub-breed the blood of superior families which may spring up in the herds of other breeders, just as Williams of Ohio has provided for the introduction into his stocks of pedigreed corn of the blood of corn mutations originating with other breeders.

The animal breeding circuit scheme was devised in part to overcome the disadvantage of the small numbers in private herds, also in part to retain superior blood once it is secured, that it may serve permanently as a source from which superior pedigreed breeding animals may be secured and thus widely disseminated. This plan quite avoids the faults of the course pursued by many wealthy breeders who gather into the one herd some of the best blood of the breed, sometimes securing the progeny of one or more mutating animals and perchance thus securing a collection of animals which if kept together and rather narrowly bred might have a high value as a permanent

source of pedigreed breeding animals. But there is often no one to continue the owner's work, or else his successors lack the genius to maintain high standards, and the herd is dissipated. Thus the circuit scheme, by banding together a group of breeders in a coöperative association and providing for a successor when a member drops out, makes permanent the sub-breed.

Here, as in the selection for distribution of only the very few varieties of plants, the breeding of animals is narrowed down to an interbreeding group, strong physically, efficient in their special functions, prepotent in upgrading and splendid as purebred stock, whether for the production of marketable products—such as meat, milk or wool—or for work.

There are needed plant and animal breeding stations employing technical men in each logical agricultural region, certainly several in each large state. Animal breeding circuits are needed for each breed of horses, sheep, cattle, and swine, and even for poultry. Still other circuits should be very profitable to produce hybrid breeds, as between European and Indian cattle, between cattle and buffalo, between common and fat-tailed sheep; possibly also to produce breeds of deer, foxes, and other semi-domesticated species.

Few men advocate government ownership of purebred stock, and certainly those who now enjoy the individualistic business of pedigreed animal production would not favor turning this business over to governmental agencies. On the other hand, nearly every person agrees that it is the proper function for the federal and state governments to so coöperate with coöperating groups of breeders as to give governmental supervision and aid so as to have scientific plans carried out which will compass all that science can do when large numbers are handled in a scientific way. The greatest example we have of circuit schemes of breeding is the circuit breeding of corn, as centered in the Ohio Experiment Station at Wooster, with which many breeders of pedigreed corn coöperate. Here the public scientists give direction, but the farmers get the educational, inspirational, and economic value of doing the work. The North Dakota Holstein Breeding Circuit is making very satisfactory progress; and the Minnesota Milking Shorthorn Breeding Circuit is doing well, excepting that it lacks the needed large number of herds.

Many people shrink from developing large projects in breeding. But the possibilities along this line are as great as in the public and private irrigation and other engineering projects. There are needed more men who can plan enterprises in breeding, and especially men

who can take these plans and stay by them for the long period of years necessary to get results. The business of breeding plants and animals by scientific organizations only awaits general demonstrations showing the large things which can be accomplished to gain its place as one of the important affairs of public and private interest.

AN OPENING AND A NEED

The editors have received a request to recommend a man trained in genetics as a teacher and researcher in a state university. A man is wanted who is not only strong on animal breeding and well trained in statistical methods, but qualified also to head a department of genetics, to direct the work of assistants, and coöperate with practical breeders.

The fact that such a place goes hunting for the right man brings forcibly to view certain features concerning our animal breeding. The men who breed pedigreed animals, write books on animal breeding, and edit periodicals for animal breeders have been caught napping. They have too long remained content with a philosophy half a century old, which is dim, unscientific, and impractical. These men should rub their eyes and observe that the days of Manly Miles and his book attempting to interpret Darwin's great work have passed. They need to take stock of the new order of things and to look about them for a more scientific and vastly more practical basis for the work of creating new values in our breeds of domestic animals.

Our agricultural colleges are especially in need of developing instruction and research in genetics in relation to the improvement of domestic animals. Our breeders are expending vast sums of money in experiments which, because of a lack of scientific direction, are largely futile. The majority of our farmers are using either scrub stock, grades so crossed as to be often little better than scrubs, or pedigreed animals of indifferent character. That a large number of the latter are thrown out by any efficient system of advanced registration based on performance shows that even the pedigreed breeds are in need of scientific improvement. The results of the Jersey and Holstein advanced registry work are clear proof of the fact that our pedigreed breeds need to be placed on a performance record basis.

The stale contention that the production of meat breeds, breeds of work horses, and dual purpose breeds of sheep and chickens can not be placed on a basis of performance records is finally beginning to give way.

The breeding of corn, cotton, flax, apples, wheat, alfalfa, and other crops is being placed on a scientific basis; yet in each case there were problems which a dozen years ago seemed vastly more difficult than the problem of placing the breeding of Percheron horses, Shorthorn cattle, short-grass-country sheep or such dual purpose chickens as Plymouth Rock on a performance record basis. For our colleges of agriculture to sit idly by and not prevent such monstrous travesties on economic production as the division of a breed into three breeds of different colors instead of applying the same science and energy to the reduction of the cost of meat and eggs is evidence of lack of interest in that line of production. What are our so-called biologists doing that they persist in being "interested" in plant and animal life and not practical in making that life more useful? Why have we not developed more animal husbandry scientists who have seen more deeply into genetics than does the devotee of the show ring and the sales ring, where the phenomenal individual wins over the genetic mutant?

There are signs of a scientific awakening in animal breeding such as occurred in plant breeding a decade ago. As then the plant breeders learned and received inspiration from the animal breeders, so now the animal breeders can learn and gather inspiration from the plant breeders. Those who devote themselves to research in animal heredity especially need to keep in touch with those who experiment with heredity in plants, and those who would devise methods of improving a breed or creating a new breed of animals should study the methods of those who improve varieties of plants, or create new varieties. The deviser of methods for creative animal breeding is especially interested in the methods which are successfully used in creating new values in open-pollinated species, such as corn and cotton; here the process is much the same as in creating new breed values of animals.

Twenty years ago those of us who desired to enter the field of experimental animal breeding found experiment station governing boards and legislative bodies not ready to furnish the necessary large number of animals with which to study the improvement of the heredity of the breeds. Now the situation is very different. The authorities are ready to be shown. Scientific agriculture has so fully made good that this branch of betterment work may now go forward, along with plant breeding, soil improvement, and other leading methods of increasing the production of food at less expense.

In all the state colleges where live stock is a leading interest there is need of a division in charge of live stock breeding, quite unhampered

with general institutional administrative duties. This division should pay especial attention to the education of men who can work as public officers or as private breeders in placing our animal breeding on a scientific basis. It should have large opportunities to give graduates training both in the art and in the science of animal breeding, as in the management of all forms of coöperative breeding, from the mere cow-testing association to the highly developed circuit for breeding the various classes of horses, cattle, sheep, swine, and poultry. Its own experiment station and branch station farm herds often can be most useful parts of the breeding circuit, and in many cases these herds will serve as a means of working out the details to be used on the privately owned herds of the circuit.

The very profitable market for circuit-bred animals bearing a government pedigree based on performance records will eventually become so remunerative to the coöperating breeder and to the state that there will be ample support for research, practical demonstration, and creative work in animal breeding. Numerous young men with instincts both for live stock and for research should take up practical live stock genetics. The demand will not be met in a decade, if in a generation. At present this field offers better openings for careers than forestry, engineering, chemistry, law, medicine, or most other professional lines.

NEWS AND NOTES

ON THE NATURE OF HEREDITY

Since Bakewell pronounced his famous law, "Like begets like," both practical men and scientists have done their best to determine just what heredity is. The original view was that "Heredity is the force which causes offspring to resemble the parents." The tendency to vary was looked upon as a force opposed to heredity. For years this view was held, but the last decade has thrown new light on the subject.

J. Arthur Thomson, in *Heredity*, defines it as the relation existing between an individual and its ancestors or offspring. He has here abandoned the old view that it is a distinct force, but looks on it merely as an existing chain uniting resemblances in different generations. This view has merit, in that it divorces one's mind from the general idea that heredity is a distinct entity or force.

Caspar L. Redfield of Chicago has looked into this subject from the standpoint of an engineer and physicist, and says that heredity is the inertia of living organisms where two or more generations are involved. Transmission is the act of passing this inertia from one generation to the next. Inertia is the tendency of a body in motion to stay in motion or at rest to stay at rest. It is usually applied to non-living matter; but the comparison is apt, as then heredity would represent the inertia of a moving body while the individual is growing, and the inertia of a body at rest when full development is reached. While the comparison is not accepted as absolute, it offers an interesting field for one who would bring his breeding work to mathematical accuracy.

The current belief of biologists at the present time is that heredity is the ability of living matter to react or respond to its environment. Certain definite processes take place in the vital functions of an individual in response to certain causes or stimuli which exist in the environment or surrounding matter. As, for example, spring causes the shedding of the coat in the domestic mammals, and fall and winter produces a heavier one. In this case most mammals respond in a similar way to the same stimulus and in a manner different from reptiles. In the same way we find different responses in different breeds, in different families, and in different individuals. Heredity constitutes a response to the same stimulus in the same way between generations, varieties, breeds, species, etc. Variation then would not

be essentially different from heredity, response either not being so complete or more complete; or else reaction to environment sets an entirely new series of changes at work and a different result ensues. This latter offers a favorable field and does not differ markedly from some other ideas not mentioned except as they are looked at through the eyes of different individuals and from different standpoints. These ideas are most fruitful of future result. Some may criticise this, but if it be remembered that for certain organs and functions the presence and action of other organs and functions corresponds to external stimuli, then a logical phase results throughout. All life processes are physical or chemical in nature and under similar conditions will be always the same.—E. N. WENTWORTH, *Ames, Iowa*.

SIZE OF FARMS AND FARM FAMILIES

The agricultural survey work in Tompkins County, New York, has shown that fair-sized farms, 160 to 300 acres, pay much better than small farms for general farming. Farmers on less than 100 acres are not often doing any better than hired men. The work has now been extended to two other counties with very different conditions, but the same results were found.

The editorial in Volume II, No. 2, of this *Magazine* raises the question of the danger to the character of the citizenship from such a farm. It is suggested that the writers have given too much attention to the economic side and not enough to the social side. We may say that our purpose has been to find out the facts. We have had nothing to do with making the facts. We had no theories to prove. Most of the conclusions have upset any theories that we did have when the work was started. The editorial also gives the impression that such farms call for large numbers of a permanent hired-man class and might go so far as to have only a few landowners in a school district. The following quotations show that no such condition exists or is likely to exist in New York.

> This does not mean that large "bonanza" farms are to develop. We have no figures for such farms, as none of them exist in this county. The group of largest farms averages only 261 acres. All the farms are the typical American "family farm," on which the farmer and his family do the major part of the farm work. Even on the farms containing over 200 acres, the family does half of the farm work. These figures may, therefore, be taken as suggesting the most profitable size for a family farm. The larger farms seem to be better than the smaller ones for this purpose. (Page 416.)
>
> These figures do not throw any light on the desirability of the very large farm on which the farmer is so busy managing that he does not do any manual

labor. From observation the writers are of the opinion that such farms have many serious obstacles in their way. They are not likely to be able to handle labor effectively. The farmer who works with his men and directs them as he works, and who treats his hired men as equals, has a great advantage. (Page 416.)

For general farming, these figures show that a farm should contain at least 150 acres. The upper limit of area is determined chiefly by the layout. With ideal conditions, with the buildings in the center of the farm, and with a public road running past the buildings, as high as 600 acres may be run from one center. With more than this area, the distance of the fields from the buildings is usually too great. It is not often that one can secure so large an area well located with respect to buildings. The most profitable general farms in Tompkins and Livingston counties contain about 200 to 300 acres of good land. (Page 427.)

These farms do not call for any permanent hired-man class. On the group of largest farms, even those above 200 acres, the labor is half done by the farmer and members of his family not receiving wages. The unpaid family labor is nearly three times as much as on the small farms. Certainly there is no injury to society from a condition that provides work for the children at home so that they do not have to leave home to find it. In many cases, the hired man is the owner's son who has staid at home because there was a chance. On the small farm there was no such chance; hence, the boys have gone to town or if not entirely disgusted with farming have gone to the larger farms of their neighbors to become hired men. There is no danger to society from a size of farm that calls for one or two hired men on each farm. It takes a number of years to earn money enough to start farming. One or two hired men per farm just about provide places for the young men who are getting started in farming. Certainly there is no danger in a system that provides places for the man with no capital while he is working up. In the regions thus far studied, there are very few men of ordinary intelligence who remain hired men permanently. They pass on to become tenants and owners, to make place for more young men. There are a very few men who will always be hired men because they are not able to manage themselves, either because of lack of ordinary intelligence or because of drink. For such persons, a chance to be a hired-man is a blessing.

It is suggested that small farms with coöperation will solve the problem. There are physical difficulties that cannot be overcome by this means. Too small fields cannot be tilled economically even if you borrow your neighbor's plow. One of the great points in economy is the driving of two, three, and four-horse teams. But such teams cannot work well in small fields even if two neighbors do combine.

The farms themselves must be joined to get the full advantage of economy of production. But partnerships in farming are not often successful; there are too many points on which the two bosses disagree.

I believe that any unprejudiced enthusiast on eugenics, if he could go with us to the three thousand farms that we have studied in various parts of New York, would agree that the family farms of 150 to 300 acres for general farming are much better than the smaller farms from the standpoint of citizenship as well as from the standpoint of profits. Such farms are large enough to permit horses and machinery to be used effectively, and large enough also to give the boys profitable work at home.

No American institution is imperiled. Farmers are merely becoming more efficient. Our Eastern farms were laid out in the days of the grain cradle. The number of men that were then necessary to farm 100 acres can now farm 200 and do it better.—G. F. WARREN. *Cornell University, Ithaca, N. Y.*

BREEDING FOR COLOR ADJUSTMENT UNDER CERTAIN CLIMATES

My observations on the effects of light and heat on the organism of animals have elicited some extremely important facts as to the survival value of colors. My former ignorance of the reasons why the Arab horse in a hot climate with his black skin tends to have white hair, and the Chinese pony in a cold climate the same, cost me exactly $200 ten years ago, and if the Government will act on the hint it will save $200,000 in a very short time. Breeders must breed for color where color enhances work, power, and endurance. * * * *

Since then, I have obtained other facts which lead me to believe the matter of color in animals much more important than I formerly thought. The white horse or mule is particularly fitted for climates where the day is hot and the night cool, for by reflecting sun rays it remains comfortable when the black dies of thermic fever; and at night it does not radiate to colder surroundings, remaining comfortable when the black gets pneumonia even though blanketed.—CHAS. E. WOODRUFF, *Surgeon U. S. Army, Panay, P. I.*

THE FOURTH INTERNATIONAL CONFERENCE ON GENETICS

The fourth International Conference on Genetics was held in Paris, September 18 to 23, under the auspices of the National Horticultural Society of France. The preparations for this gathering were commenced more than a year in advance of the date of meeting. A

strong local committee was formed, presided over by Dr. Viger, senator, and president of the National Horticultural Society of France, and with Mr. Philippe de Vilmorin as secretary, to whose untiring efforts a large measure of the success of the conference is due.

About two hundred and forty members were registered and about fifty communications were presented, of which the majority dealt with subjects of a botanical nature. Most of the leading countries in Europe were represented, and delegates were present also from Northern Africa and from the United States and Canada.

It is impossible, within the space of a short notice of this kind, to give abstracts of all the papers presented, and any attempt to select the most important from among them would be undesirable and perhaps futile. It will be sufficient to state that highly important communications bearing on Mendelian theory were presented by such eminent leaders as Bateson, Tschermak, and others, while many papers of a somewhat simpler and more immediately practical character were also given. Some of the communications were illustrated by lantern slides, and others by plain or colored drawings. It is intended that all the papers presented shall be published in full in the volume of proceedings which is to be issued, and where illustrations are of importance these will probably be reproduced. The average quality of the communications presented was certainly of a high order, and although the use of four languages (French, German, English, and Italian) added considerably to the difficulties of the majority of the audience, the papers were received, as a rule, with careful attention and every evidence of appreciation.

Two of the shorter and therefore less conspicuous communications were of special interest to the writer of these notes, and he may therefore, perhaps, be allowed to refer specially to them. Professor von Rumker of Breslau presented very briefly some of the results obtained by him in carrying on selections of rye for color of grain. He exhibited samples of seven different colors, three of which—dark brown, straw yellow, and bright green—now breed true. Dr. Jesenko of Vienna made the interesting announcement that he has succeeded in obtaining a fertile plant by crossing wheat with rye. Although only one seed was obtained from the plant of the first generation, Dr. Jesenko was fortunate enough to obtain one hundred and fifty-two seeds from the plant of the second generation.

In addition to the papers presented before the conference, attention should be called to a pamphlet on genetics by Mr. Philippe de Vilmorin, copies of which were given to all those in attendance at the convention. This excellent little pamphlet gives a brief account of the

origin of the new science of genetics, with a bibliography (classified by subjects) of important publications bearing upon it and a list of all the papers presented at the previous International Conferences namely, London in 1899, New York in 1902, and London in 1906.

From our side of the Atlantic the following papers were presented: W. A. Orton, Obtaining Disease-Resistant Varieties of Plants. F. M. Surface, Results of Selections Among Fluctuating Variations. W. T. Swingle, Variations in the First Generation of Citrus Hybrids. C. E. Saunders, Breeding Varieties of Wheat of High Baking Strength. G. N. Collins and J. H. Kempton, On the Inheritance of Waxy Endosperm in Hybrids of Chinese Corn. These papers, with the exception of that last mentioned, were presented by the authors themselves.

The programme of the conference included five sessions for business of about three hours each, three receptions (by the Horticultural Society, the municipal council and Prince Roland Bonaparte), five excursions and visits to important institutions (to the Pasteur Institutes at Paris and at Garche, to the Vilmorin Trial Grounds at Verrières and to the Veterinary School and the Natural History Museum), and two elaborate repasts (a luncheon at the Vilmorin grounds and a closing banquet at the Continental Hotel.) The social side of the convention was managed with the utmost care and with attention to every detail that good will and hospitality could suggest. Nothing was left undone to make the foreigners feel that they were really guests and friends. The hours for social intercourse proved not only most enjoyable but very profitable, as they afforded opportunities for becoming acquainted with fellow-workers in various parts of the world and for conversation in regard to details of their work which were not presented in their written papers. The closing banquet was an event of which even Paris might well be proud, since it was characterised not only by an admirable menu but by a delightful series of speeches, not one of which was dull or too lengthy, and by a timely adjournment to a smaller room where groups gathered for coffee and conversation and for the saying of farewell.

The request of the American Breeders Association that the next International Conference should be held under their auspices in America was presented to the conference, but no decision was reached in regard to the matter. An influential committee, with Professor Bateson as chairman, was appointed to consider and decide upon the date and place for the next conference. It is not expected that the decision of this committee will be announced for a considerable time.—C. E. SAUNDERS, *Ottawa, Canada.*

A SELF-SEEDING DOUBLE PETUNIA

Mrs. Myrtle Shepherd Francis, member A. B. A., Ventura, Cal., reports the successful production of a self-seeding double petunia. Mrs. Francis, who specializes in breeding this flower, has a collection of over five hundred plants with double blossoms in a variety of colors. Several years ago the originator observed a number of flowers with rudimentary pistils and ovaries and as a matter of experiment pollenized them. After numerous trials she was rewarded with two partially formed seed pods. This year, only five per cent of the flowers grown from seed turned out singles. Selection will probably reduce this to a still lower figure.

Mrs. Francis is developing also a yellow petunia and is working with poppies and the white and red flowering clianthus.

FESTBAND IN COMMEMORATION OF MENDEL

The Naturforschender Verein of Brünn is about to publish a commemorative volume in honor of Gregor Mendel. About a year ago the simple and beautiful Mendel monument was unveiled at Brünn in the presence of a large number of scientists, or, better, Mendelians, and the work in question is proposed to follow as a literary tribute or monument to the great and modest man who has handed to the world the keys with whose aid the outer doors behind which are guarded the secrets of heredity were unlocked. The contents of the Festband follow:

Mendel, Gregor, "Versuche über Pflanzen-Hybriden."
Mendel, Gregor, "Hieracium-Bastarde."
Mendel, Gregor, "Die Windhose vom 13. Oktober 1870."
Baur, Erwin, Berlin, "Ein Fall von Faktorenkoppelung bei Antirrhinum majus."
Cuénot, L., Nancy, "L'Hérédité chez les Souris."
Fruwirth, C. Wien, "Zur Vererbung morphologischer Merkmale bei Hordeum distichum mutans." (Mit 5 Abbildungen auf 2 Tafeln.)
Hagedoorn, L. Arend, Verrières le Buisson, "The Interrelation of Genetic and Non-genetic Factors in Development."
Hurst, C. C., Burbage, England, "Mendelian Characters in Plants, Animals, and Man."
Iltis, Hugo, Brünn, "Vom Mendel-Denkmal und von seiner Enthüllung." (Mit 2 Tafeln.)
Kammerer, Paul, Wien, "Mendelsche Regeln und Vererbung erworbener Eigenschaften."
Nilsson-Ehle, H., Svalöf (Schweden), "Spontanes Wegfallen eines Farbenfaktors beim Hafer." (Mit 4 Figuren.)
Porsch, Otto, Wien, "Die ornithophilen Anpassungen von Antholyza bicolor Gasp." (Mit 2 Tafeln und 1 Textfigur.)

Przibram, Hans, Wien, "Albinismus bei Inzucht."

Roux, Wilhelm, Halle a. d. S., "Über die bei der Vererbung blastogener und somatogener Eigenschaften anzunehmenden Vorgänge."

Semon, Richard, München, "Die somatogene Vererbung im Lichte der Bastard- und Variationsforschung."

Shull, George Harrison, New York, "Defective Inheritance-Ratios in Bursa Hybrids." (Mit 6 Tafeln.)

Tschermak, Erich von, Wien, "Über die Vererbung der Blütezeit bei Erbsen." (Mit 3 Tafeln und 2 Textfiguren.)

PUBLICATIONS RECEIVED

DIE SYSTEMATIK UND METHODIK DER MODERNEN LANDWIRTSCHAFTLICHEN PFANZENPRODUKTIONSLEHRE. Prof. Dr. von Rumker, Breslau. Reprint from Frühlings Landwirtschaftliche Zeitung. 1911. pp. 409–421.

IMPROVEMENT IN CORN. H. K. Hayes and E. M. East. Bulletin 168, Connecticut Agricultural Experiment Station. 21 pp. 4 plates.

This bulletin discusses the methods of producing crosses from distinct types of corn and the value of the seed of those crosses for commercial crops. From tests conducted at the Connecticut station and elsewhere, the authors conclude that the fact of the increased vigor of first-generation hybrids of corn is of commercial importance, and that the project is worthy of further trial.

The Connecticut Agricultural Experiment Station is desirous of entering into coöperation with farmers to thoroughly test the value of first-generation corn hybrids for the production of commercial corn crops.

A comparative test of hybrid and parent varieties, sent in by seven farmers coöperating with the station, resulted in showing that five of the crosses proved beneficial, giving higher yields by from 7 bushels to 44 bushels than the parent varieties grown alongside.

REPORT OF THE BOTANICAL DEPARTMENT, NEW JERSEY AGRICULTURAL COLLEGE EXPERIMENT STATION, 1910. B. H. Alfred Groth, Early J. Owen, Mary Robinson.

Plant heredity studies are reported with beans, corn, eggplants, opra, peas, peppers, squashes, and tomatoes. Plant sap circulation, plant toxicology, and plant shading also receive attention.

HERSELF. Talks with Women Concerning Themselves, E. B. Lowrie, M.D. 221 pp. Illustrated. Forbes and Company, Chicago, Ill.

Herself is the third book in the series of Personal Hygiene books published by an author whose two preceding books received notice

in this department of the *Magazine*. The book before us is fully up to the high standard set by its two predecessors.

So long as our common schools, or extension schools, or schools of personal hygiene, supported by private philanthropic enterprise, do not teach the important facts of the physiology of reproduction, motherhood and heredity, there will be need for such plain common-sense books as this. No attempt is made in this book at being scientific. It is not burdened with descriptive details but emphasizes mostly the instructive features.

There is not in the entire book a term or a phrase which is not written in the plain English of the people. It is replete with sensible advice. One cannot help discovering in this book a sympathetic note coming from a woman whose experience in every stratum of society has led her to realize the need of a publication of this character.

MENDELISM. P. C. Punnett. 173 pp., 35 illustrations, 6 colored plates. Third Edition. McMillan and Company, Ltd., London.

Since the publication of the first edition of this book by the same author in 1905 Mendelism has made remarkable strides. The application of Mendel's Law as originally stated by its author—and, shall we also say, rediscoverers—has been immensely amplified, and as the experimental evidence accumulates the connection becomes clearer that Mendelism furnishes the only key we at present possess to the solution of heredity problems. Not only that, but that with the help of Mendel's Law, genetics, has become practically the only branch of biology, in which it is possible to formulate with almost mathematical conciseness, representations of expectations of heredity processes.

Repeated new editions of this book were really necessary to keep it abreast of advances and in this latest edition Mr. Punnett has not only brought Mendelism up to date but he has given Mendelism a very lucid, concise and direct statement.

In separate chapters are discussed the various phases of Mendelism as understood today. Especially clear is the presentation of the subject of recombination in individuals differing in one, two, three and more pairs of characters. Brief chapters take up the presence and absence theory, interaction of factors, reversion, dominance, wild forms and domestic varieties, repulsion and coupling of factors, sex limited inheritance, variation and evolution and so on, concluding with a chapter on Man and possible application of Mendelism to eugenics.

The reviewer is of the opinion that the general reader of scientific inclinations, as well as the student will find this book valuable as a treatise as well as text book.

ASSOCIATION MATTERS

GROWING POPULARITY OF THE AMERICAN BREEDERS ASSOCIATION

On December 26 last, Dr. A. W. Gilbert, professor of plant breeding at Cornell University, Ithaca, New York, sent in a batch of 102 new members, being mostly members of the New York State Breeders Association. These 102 men are a most welcome addition to the Association, and both the New York State Breeders Association and the American Breeders Association will greatly benefit by this arrangement. The prestige and assistance of the national organization will no doubt be of direct value to the state organization.

The accession of this large number of members of the New York State Breeders Association in a body speaks well for the popularity of the American Breeders Association and is an index of the growing confidence of the practical breeders in the propaganda of the American Breeders Association. Other organizations of live stock breeders are invited to take memberships in the American Breeders Association so that the national organization may rapidly grow to large proportions in order that it may make its work and plans more effective.

THE EIGHTH ANNUAL MEETING

The eighth annual meeting held December 28, 29 and 30 in Washington in affiliation with the American Association for the Advancement of Science was a decided success, in point of attendance, in the number and quality of papers and addresses submitted, and in general interest and enthusiasm. In fact this session surpassed all previous ones in these respects and a good part of our attendance was from scientists belonging to other biological societies.

A large number of new members were enrolled. Mr. T. V. Munson of Denison, Texas, and Dr. Wm. Saunders, Ottawa, Canada, were elected honorary members of the Association.

The Council decided to take steps to organize branch chapters of the Association at all the larger centers of education.

PORTRAITS OF SCIENTISTS AND BREEDERS

There are left a number of copies of the portraits of scientists and breeders, whose biographies were published in the first volume of the *Magazine*. The price of these portraits, which are done in sepia tone on sepia paper, is 10 cents each. A set of these portraits should be framed and hung in every lecture room for plant and animal breeding.

COMPLIMENTARY WORDS FOR THE MAGAZINE

I find the *magazine* very interesting and in fact almost necessary among the breeders of the country. I of course could not afford to be without it or not to be a member of the Association. I shall do what I can in the coming year to further its interests in the enlisting of new members.—GEO. F. FREEMAN, *Tucson, Ariz.*

I enclose check for $2 for renewal of my membership in the Breeders Association, in reversal of my decision of a week since. For I have just read Dr. Van Eedon's article in the August *World's Work*, which has placed the need of eugenics stronger than I ever saw it put before. Two years ago I was interested in the breeding of corn. This has set me to thinking that perhaps the breeding of men is the only hope for the race.—O. E. BAKER, *Madison, Wis.*

We desire to congratulate you upon the splendid *Magazine*, and we wish you all the success so deserving an effort merits.—L. F. BEALE, *Manager, Associated Farm Press, Chicago, Ill.*

I want to say that I consider the last report and the *Magazines* published to be the best ever and that they are worth many times the price of the annual dues.—WM. F. NYE, *San Juan, P. R.*

MEMBERSHIP DUES FOR 1912

Notices of memberships which were due to be paid in the first quarter of 1912 will soon be sent out. Members are respectfully requested to remit promptly and thus save the Secretary's office the expense of later notices.